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ASSESSMENT OF DAMAGE TOLERANCE REQUIREMENTS AND ANALYSES - TASKS II AND IV REPORT

Volume IV - Raw Test Data

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Fairchild Industries
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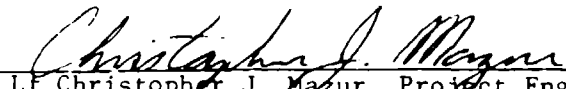
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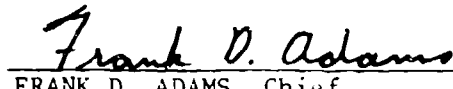
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<p>Structural test program of typical aircraft structural configurations was conducted to assess the current Air Force damage tolerance design requirements defined in MIL-A-83444. The specimens, made of 2024-T3XX and 7075-T6XX, were subjected to randomized flight-by-flight spectra, representative of fighter/trainer and bomber/cargo type loading spectra, respectively, and to constant amplitude loading spectrum. A total of seventy-two (72) specimens were tested. The test results were correlated with analytical predictions using crack growth and crack initiation methods. As a result of this study, recommendation is provided to the validity of MIL-A-83444, to develop guidelines for selection of critical crack locations, and to assess the state-of-the-art analytical capabilities in predicting crack growth and crack initiation time.</p> <p>This volume, Volume IV of a five volume report, presents the raw test data associated with Task II and IV of the program.</p>					
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FOREWORD

This report is prepared by Fairchild Industries, Fairchild Republic Company for the United States Air Force under a research and development program entitled "Assessment of Damage Tolerance Requirements and Analyses," Contract No. 33615-82-C-3215. This program is being administered by the Flight Dynamics Laboratory, Air Force Wright Aeronautical Laboratories, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. Mr James L. Rudd (AFWAL/FIBEC) was the Air Force project engineer through December 1985. Subsequently, Mr Rudd was replaced by Lt Christopher Mazur. A. Kuo was the Program Manager and Principal Investigator through March 1985. Subsequently, Mr Kuo was replaced by Meir Levy for the completion of the program. The structural test program was performed at the University of Dayton Research Lab under the supervision of George Roth.

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1.0 INTRODUCTION

Eight major tasks listed below have been planned to achieve the program objectives. Namely, (a) assessing the validity of, and recommending improvements to MIL-A-83444, (b) developing guidelines for identifying the most critical initial primary damage locations for typical aircraft structures, and (c) assessing and improving the state-of-the-art analytical methods to satisfy the requirements of MIL-A-83444.

- Task I: Analytical Methods
- Task II: Basic Tests
- Task III: Analytical Predictions
- Task IV: Structural Tests
- Task V: Analytical/Experimental Correlations
- Task VI: Assessment of and Recommended Improvements to MIL-A-83444
- Task VII: Guidelines for Selecting Most Critical Initial Primary Damage Location
- Task VIII: Assessment of and Improvements to Damage Tolerance Analyses

The purpose of this report is to present the Test Data obtained from the Basic Test Program (Task II) and the Structural Test Program (Task IV). The test data will be correlated with Analytical Predictions (Ref. Volume III), to assess the state-of-the-art capability in predicting crack growth and crack initiation of specimens representative of typical aircraft structure.

The Basic Test Program included sixty (60) tensile specimens used to establish static allowables for the material used during the Structural Test Program. It also included eighty (80) crack initiation specimens to evaluate fatigue initiation allowables used during the analytical prediction of crack initiation. The fracture toughness allowables for the material form used, were evaluated using twenty (20) center crack tension 'CCT' type specimens. These specimens provided fracture toughness and fracture resistance curves (R-curves) for the

material used during the Structural Test Program. Constant amplitude crack growth rates were also evaluated using sixty four (64) 'CCT' specimens.

The material selected for the entire program was 7075-T6XX and 2024-T3XX to represent typical bomber and fighter wing material, respectively. The loading spectra chosen were the 'AMAVS' randomized loading spectrum to represent a bomber/cargo type aircraft and the 'A-10A' loading spectrum to represent a fighter/trainer type aircraft (Ref. Appendix A). An additional loading spectrum was constant amplitude. This spectrum was determined based on its equivalence in damage to the A-10A flight spectrum. Both the 'AMAVS' and the 'A-10A' loading spectra contained marker band loadings applied at predetermined intervals. Verification of the 'AMAVS' marker band loading was established prior to the structural test via simple coupon tests.

The Structural Test Program included thirty-six (36) lap-joint specimens, and thirty-six (36) stinger reinforced specimens. The purpose of the Structural Test Program was to evaluate the analytical methods capabilities in predicting crack initiation and crack growth of structural configuration typical to those found in aircraft construction.

2.0 TENSILE TESTS PROGRAM

The purpose of the tensile test program was to establish the material acceptability and to provide the static allowables of the material selected. The parameters evaluated included yield, ultimate allowables, and percentage elongation. The tests were performed in two grain directions, namely, longitudinal and transverse directions. The testing set-up and requirements were in accordance with ASTM standard E-8.

2.1 TEST SPECIMENS

Sixty (60) specimens were fabricated and tested. The material selected to represent attack/fighter/trainer aircraft was 2024-T3XX aluminum alloy. Four (4) product forms were selected:

<u>MATERIAL</u>	<u>PRODUCT FORM</u>	<u>THICKNESS (IN)</u>
2024-T3	Sheet	0.090, 0.190
2024-T351	Plate	0.250
2024-T3511	Extruded Tee	0.190
2024-T3511	Extruded Angle	0.250

The material selected to represent bomber/transport/cargo aircraft is 7075-T6XX aluminum alloy which is used in the wing structure of aircraft such as C-5A, DC-8 and the B-52. Four (4) product forms were selected:

<u>MATERIAL</u>	<u>PRODUCT FORM</u>	<u>THICKNESS (IN)</u>
7075-T6	Sheet	0.160
7075-T651	Plate	0.312, 0.400
7075-T6511	Extruded Tee	0.312
7075-T6511	Extruded Angle	0.312

2.2 TEST ENVIRONMENT

The tensile specimens were tested in controlled lab air environments. They were fabricated by FRC and tested by the Dickson Testing Co., located at South Gate, California.

2.3 TEST RESULTS

The tensile properties of sixty (60) coupons are presented in Table 2-1 and 2-2 for 2024-T3XX and 7075-T6XX aluminum alloys, respectively. The raw test data were processed in accordance with ASTM Standard E-8. All the tensile properties, except those marked with asterisks, met the requirements given by the Federal Specifications QQ-A-200/11D, 3D and QQ-A-250/12E, 4E. Those data marked with asterisks are below the A-Allowable specified in MIL-HDBK-5D. The corresponding A-Allowable is given in parenthesis. A comparison shows that the largest deviation is 4% below the A-Allowables.

TABLE 2-1. TENSILE PROPERTIES OF 2024-T3XX

PRODUCT FORM/ MATERIAL	DIRECTION	YIELD STRENGTH (ksi)	ULTIMATE STRENGTH (ksi)	ELONGATION (%)	YOUNG'S MODULUS (ksi)
0.19 Sheet (2024-T3)	Longitudinal	53.1	67.7	15.5	10,900
		52.9	66.3	13.5	11,000
		53.3	68.1	13.5	10,300
	Transverse	45.0	66.9	18.0	11,000
		44.7	67.2	18.0	11,000
		45.3	67.4	18.0	11,000
0.09" Sheet (2024-T3)	Longitudinal	52.8	68.9	17.5	11,900
		52.9	69.1	17.5	11,000
		53.0	68.9	16.0	11,400
	Transverse	47.5	67.7	21.0	10,600
		38.4*(40)	67.5	17.5	9,400
		41.7	67.3	19.0	10,600
0.25" Plate (2024-T351 Plate)	Longitudinal	51.2	70.2	20.5	10,800
		51.0	69.9	21.0	10,300
		51.0	69.9	19.0	10,400
	Transverse	45.3	67.0	18.5	11,000
		45.6	67.1	19.0	10,700
		45.3	67.0	19.0	11,400
0.19" Tee (2024-T3311 Extrusion)	Longitudinal	53.5	67.8	17.5	11,400
		53.1	67.6	18.5	11,200
		53.2	66.8	17.5	10,400
	Transverse	50.8	53.6*(54)	-	11,200
		50.4	66.9	8.0	9,800
		50.4	67.2	7.0	11,200
0.25" Angle (2024-T3511 Extrusion)	Longitudinal	47.9	62.7	22.5	11,200
		47.7	62.2	21.0	11,300
		47.2	61.9	20.5	10,800
	Transverse	44.8	55.3*(56)	10.0	11,700
		41.7	53.9*(56)	12.0	10,700
		43.2	67.5	10.0	8,400

*Below A-Allowable

TABLE 2-2. TENSILE PROPERTIES OF 7075-T6XX

PRODUCT FORM/ MATERIAL	DIRECTION	YIELD STRENGTH (ksi)	ULTIMATE STRENGTH (ksi)	ELONGATION (%)	YOUNG'S MODULUS (ksi)
0.31" Plate (7075-T651 Plate)	Longitudinal	77.6	82.7	13.5	10,200
		78.1	82.7	13.0	10,200
		78.1	82.7	14.0	9,800
	Transverse	75.3	84.0	12.5	9,900
		75.9	84.5	11.5	9,700
		75.1	83.9	14.5	10,900
0.16" Sheet (7075-T6 Sheet)	Longitudinal	76.5	81.5	15.0	10,600
		77.3	82.2	15.0	10,100
		77.8	81.0	15.0	10,400
	Transverse	74.0	84.1	13.5	11,000
		73.8	84.3	13.0	10,700
		73.8	84.4	13.5	10,700
0.4" Plate (7075-T651 Plate)	Longitudinal	77.2	79.7	15.0	11,100
		77.7	79.4	13.5	11,100
		76.7	79.7	13.0	11,100
	Transverse	73.2	79.6	11.5	10,500
		72.0	79.5	11.5	10,800
		72.7	79.2	11.5	10,800
0.31" Tee (7075-T6511 Extrusion)	Longitudinal	78.6	86.0	13.5	10,400
		79.1	86.3	12.5	11,400
		79.1	86.3	12.5	10,900
	Transverse	71.3	77.1*(78)	9.0	10,300
		69.2	76.3*(78)	10.0	10,200
		68.8	76.5*(78)	9.0	10,300
0.31" Angle (7075-T6511 Extrusion)	Longitudinal	82.4	89.0	12.5	10,500
		83.7	90.3	11.5	10,000
		81.9	88.3	11.5	10,800
	Transverse	76.6	85.5	7.0	11,100
		77.8	85.3	13.0	9,700
		77.2	84.9	13.0	9,900

*Below A Allowable

3.0 CRACK INITIATION TEST PROGRAM

The purpose of the crack initiation test program was to provide fatigue initiation allowables of the product form used during the structural test program. The initiation allowables were fit into the strain energy density equation given by:

$$S_{\max} = S_f N^m \quad 3.1$$

where;

$$\begin{aligned} S_{\max} &= \text{the maximum strain energy density} \\ &= (\sigma_{\max} K)^2 / 2E \end{aligned}$$

N = number of cycles to fatigue failure

K = stress severity factor

S_f, m = coefficient obtained from test

The coefficients S_f and m were determined from specimens without interference fit fasteners, clamp-up and faying surface sealant (Group A, Table 3-1). Additional coupon tests using one or more of the above three parameters (Group B, C, D, Table 3-1) provided data which accounts for their presence.

Equation 3.1 together with the Damage Index ' d_1 ' (Equation 3.2) provided the data needed to predict crack initiation at the edge of a hole.

$$d_1 = C_1 - C_2 S_{\max} \quad 3.2$$

The Damage Index coefficients C_1, C_2 are found to be functions of material, and they were evaluated for 2024-T3XX and 7075-T6XX aluminum alloys.

3.1 TEST SPECIMENS

The specimen configurations, selected for this task are shown in Figures 3-1 through 3-4. They included 'one hole' specimens with and without load transfer, and 'two hole' slotted specimens with and without load transfer. The

latter specimen type was designed to simulate cracked joints, with the crack extended between two fastener holes. The amount of load transfer varied between 10% and 50%. Hi-Lok type attachments were installed with interference fit according to FRC specifications, or with clearance fit. Another two parameters evaluated were the degree of Hi-Loks clamp-up and the presence of a sealant at the faying surfaces. The two materials selected for this task were 2024-T3XX and 7075-T6XX plates to represent wing primary structure for fighter and bomber type aircraft, respectively. Each set of specimens were fabricated from one plate as shown in Figure 3-5.

3.2 TEST ENVIRONMENT

The crack initiation specimens were tested in a controlled lab-air environment. The testing was conducted at FRC testing laboratories located in Farmingdale, NY. The loading frequency was 3-5 Hz.

3.3 TEST DESCRIPTION

The test specimens were subjected to constant amplitude spectra with a stress ratio of $R=0.0$. The maximum stress varied between 9.50 ksi and 34.0 ksi, depending on the specimen configuration and material. The four groups of tests shown in Table 3-1 display an increasing complexity in test parameters from Group A to Group D. Group A test specimens did not have interference-fit fasteners, clamp-up, or sealant. The results from this group of tests are to be used for determining the coefficients in Equation 3.1. Group B test specimens have interference-fit fasteners, but no clamp-up or sealant. The results from this group of tests were to be used for determining the coefficient α . Group C test specimens have interference-fit fasteners with standard clamp-up. The results from this group of tests were to be used for determining the coefficient β . Group D test specimens have interference-fit fasteners with standard clamp-up and sealant. The results from this group were to be used for determining the coefficient γ . However, due to the relative few number of specimens tested and the scatter in test results, it was not possible to make definite conclusions concerning the effect of each variable. Therefore, a multiplication factor was obtained in terms of $\alpha\beta\gamma$.

3.4 TEST RESULTS

The crack initiation test results are summarized in Tables 3-2 through 3-5 for 2024-T3 and 7075-T651 specimens respectively. The tables include the following parameters:

σ_r	= Remote stress (= load divided by gross area).
k_t	= Theoretical stress concentration factor.
k_N	= Neuber stress concentration factor.
S	= Maximum strain density (= $1/2 (\sigma_{\max} k)^2/E$)
N_t	= Experimental number of cycles to failure.
N_{tp}	= Predicted number of cycles to failure.
N_g	= Predicted number of cycles to failure for $\sigma_0 = 0.050$ in.
d_i	= Damage index.

The Group A test data, which were obtained from those specimens without interference, clamp-up, or sealant, are plotted on Figures 3-6 and 3-7 as maximum strain energy density (S) versus cycles (N). The data points are curvefitted into the following two equations.

$$S_{\max} = 10.4261 N^{-0.3660} \quad \text{for 2024-T3} \quad 3.3$$

$$S_{\max} = 20.4257 N^{-0.4515} \quad \text{for 7075-T651} \quad 3.4$$

The Groups B, C and D test data were originally intended to obtain empirical constants α , β and γ which would account for the effect of interference, clamp-up, and sealant in the calculation of the stress severity factor, k, defined in Equation 3.5.

$$k = \alpha \beta \gamma k_N \quad 3.5$$

However, the Groups B, C and D test data, as shown in Figures 3-8 and 3-9, indicate that a distinction among α , β and γ cannot be made on the specimens representing production quality. Therefore, the product $\alpha \beta \gamma$ is utilized to account for the combined effect of interference, clamp-up and sealant. In Figures 3-8 and 3-9, a line representing the lower bound of test data is drawn

to be parallel to the line representing Group A test data. The product $\alpha\beta\gamma$ was determined by comparing the two lines shown in Figures 3-8 and 3-9. The product $\alpha\beta\gamma$ so obtained is presented below.

$$\alpha\beta\gamma = 0.8503 \text{ for } 2024\text{-T3} \quad 3.6$$

$$\alpha\beta\gamma = 0.8126 \text{ for } 7075\text{-T651} \quad 3.7$$

It should be mentioned that the product $\alpha\beta\gamma$ are conservative because they were determined from the lower bound of test data.

The total fatigue life, N_{tp} , of the various specimens were predicted using Equations 3.3 and 3.4. The crack growth life, N_g , was also predicted, using the "DAMGRO" computer program. The initial flaw for each specimen was an 0.050 inch circular corner flaw. The life required to initiate an 0.050 inch circular corner crack is defined as $(N_{tp} - N_g)$.

The Damage Index d_i vs. S of Group A and Groups B, C, D are shown in Figures 3-10 and 3-11 for 2024-T3 material, and have the following form:

$$d_i = 1.0 - 0.629 S \quad \text{Group A} \quad 3.8$$

$$d_i = 1.0 - 0.540 S \quad \text{Groups B, C and D} \quad 3.9$$

The Damage Index for Group A and Groups B, C, D for 7075-T651 are shown in Figures 3-12 and 3-13 respectively, and have the form:

$$d_i = 0.873 - 0.795 S \quad \text{Group A} \quad 3.10$$

$$d_i = 0.958 - 0.619 S \quad \text{Groups B, C and D} \quad 3.11$$

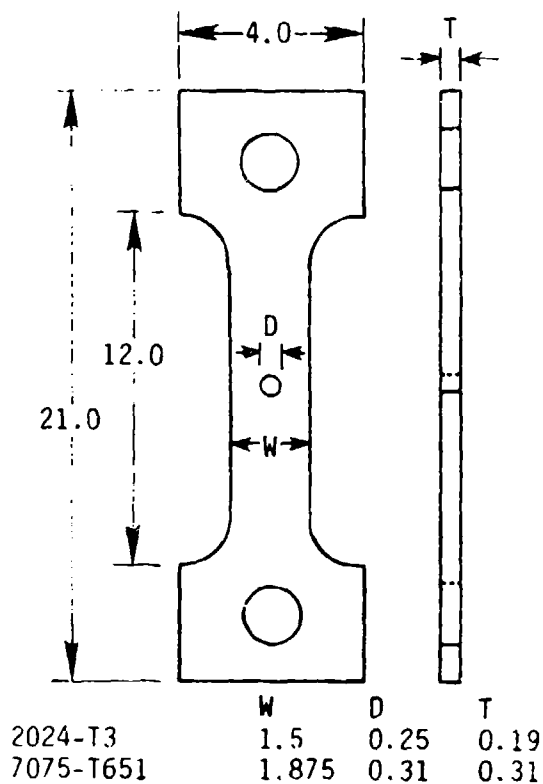


Figure 3-1. Crack Initiation One Hole Specimen

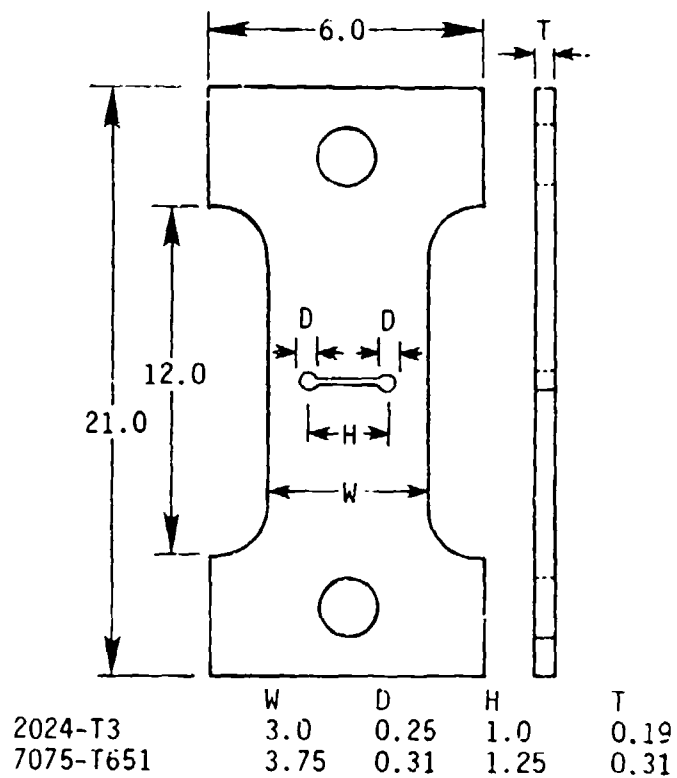


Figure 3-2. Crack Initiation Two Hole Specimen

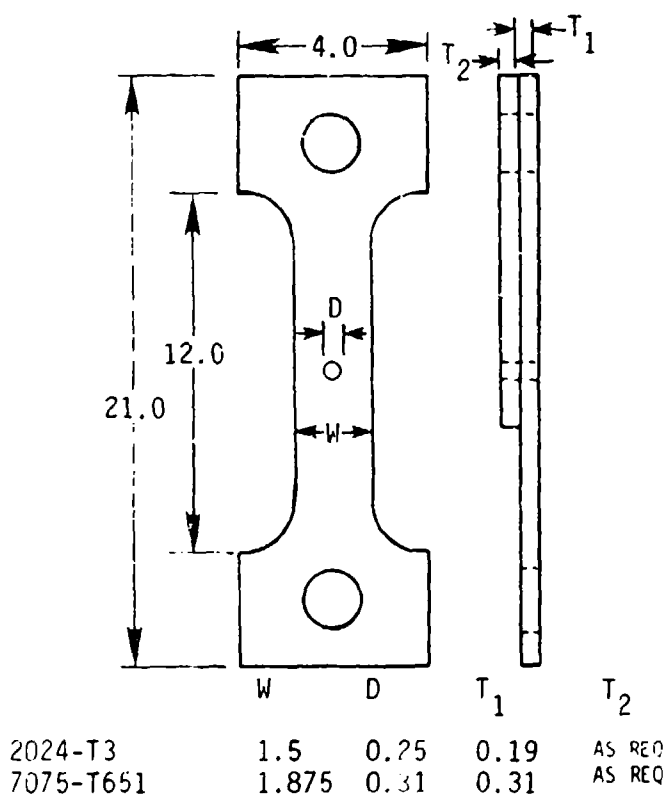


Figure 3-3. Crack Initiation One-Hole Load-Transfer Specimen

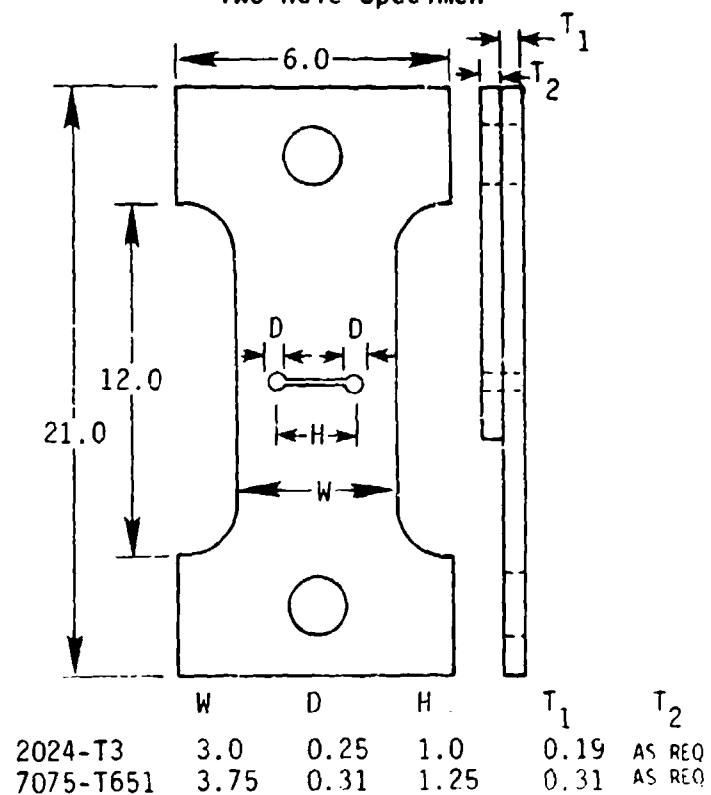
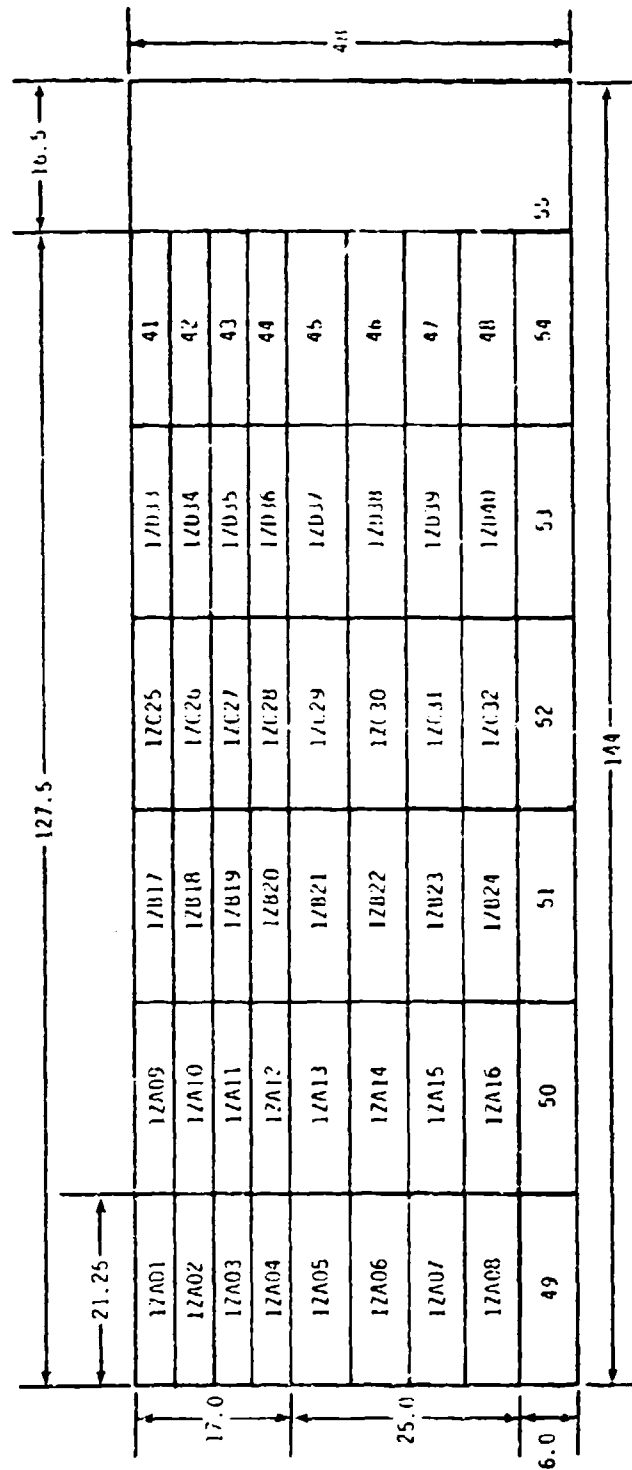


Figure 3-4. Crack Initiation Two-Hole Load-Transfer Specimen



Z = 2 for 2024-13
Z = 7 for 7075-1651

Figure 3-5. Arrangement of Crack Initiation Specimens from a Single Plate

TABLE 3-1. CRACK INITIATION TEST PLAN

		STRESS (KSI)	LOAD TRANSFER	HOLE CONDITION			CLAMP-UP	SEALANT	SPECIMEN ID
				OPEN HOLE	FILLED HOLE				
					INTERFERENCE	CLEARANCE			
GROUP A	FIGURE 3-1	34	NONE	X			NO	NO	1ZA01, 1ZA02
	FIGURE 3-1	23	NONE	X			NO	NO	1ZA03, 1ZA04
	FIGURE 3-2	16	NONE	X			NO	NO	1ZA05, 1ZA06
	FIGURE 3-2	20	NONE	X			NO	NO	1ZA07, 1ZA08
	FIGURE 3-3	31	10%			X	NO	NO	1ZA09, 1ZA10
	FIGURE 3-3	26	50%			X	NO	NO	1ZA11, 1ZA12
	FIGURE 3-4	23	10%			X	NO	NO	1ZA13, 1ZA14
	FIGURE 3-4	14	50%			X	NO	NO	1ZA15, 1ZA16
GROUP B	FIGURE 3-1	34	NONE		X		NO	NO	1ZB17, 1ZB18
	FIGURE 3-2	18	NONE		X		NO	NO	1ZB21, 1ZB22
	FIGURE 3-3	28	30%		X		NO	NO	1ZB19, 1ZB20
	FIGURE 3-4	23	30%		X		NO	NO	1ZB23, 1ZB24
GROUP C	FIGURE 3-3	34	10%		X		YES	NO	1ZC25, 1ZC26
	FIGURE 3-3	28	50%		X		YES	NO	1ZC27, 1ZC28
	FIGURE 3-4	23	10%		X		YES	NO	1ZC29, 1ZC30
	FIGURE 3-4	18	50%		X		YES	NO	1ZC31, 1ZC32
GROUP D	FIGURE 3-3	34	30%		X		YES	YES	1ZD33, 1ZD34
	FIGURE 3-3	28	30%		X		YES	YES	1ZD35, 1ZD36
	FIGURE 3-4	23	50%		X		YES	YES	1ZD37, 1ZD38
	FIGURE 3-4	18	50%		X		YES	YES	1ZD39, 1ZD40

NOTE: Z = 2 FOR 2024-T3

Z = 7 FOR 7075-T651

TABLE 3-2. CRACK INITIATION TEST RESULTS FOR 2024-T3XX

SPECIMEN ID	LOAD TRANSFER	INTER- FERENCE	CLAMP- UP	SEALANT	σ_{max} (KSI)	CYCLES TO FAILURE
12A01	Open Hole	No	No	No	34.0	11,405
12A02	↑	↑	↑	↑	34.0	11,046
12A03	↓	↓	↓	↓	28.0	20,462
12A04	↓	↓	↓	↓	28.0	21,451
12A05	↓	↓	↓	↓	16.0	8,736
12A06	↓	↓	↓	↓	16.0	7,008
12A07	↓	↓	↓	↓	20.0	3,485
12A08	Open Hole	↓	↓	↓	20.0	4,454
12A09	8.4%	↓	↓	↓	18.0	538,166*
12A10	8.4%	↓	↓	↓	18.0	37,956
12A11	29.2%	↓	↓	↓	32.0	4,110
12A12	29.2%	↓	↓	↓	32.0	13,188
12A13	4.1%	↓	↓	↓	25.0	1,128
12A14	4.1%	↓	↓	↓	25.0	1,774
12A15	32.8%	↓	↓	↓	20.0	3,791
12A16	32.8%	No	↓	↓	20.0	3,788
12A17	0	Yes	↓	↓	34.0	118,484
12A18	0	↑	↓	↓	34.0	49,616
12A19	0	↑	↓	↓	18.0	18,138
12A20	0	↑	↓	↓	18.0	11,002
12A21	24.8%	↑	↓	↓	16.0	91,857
12A22	24.8%	↑	↓	↓	16.0	77,439
12A23	26.7%	↑	↓	↓	20.0	8,226
12A24	26.7%	↑	No	↓	20.0	12,628
12A25	8.4%	↑	Yes	↓	34.0	22,435
12A26	8.4%	↑	↑	↓	34.0	15,653
12A27	29.2%	↑	↑	↓	24.0	111,843
12A28	29.2%	↑	↑	↓	24.0	32,102
12A29	9.1%	↑	↑	↓	22.0	5,037
12A30	9.1%	↑	↑	↓	22.0	55,559
12A31	32.8%	↑	↑	↓	20.0	29,085
12A32	32.8%	↑	↑	No	20.0	12,346
12A33	24.8%	↑	↑	Yes	34.0	22,834
12A34	24.8%	↑	↑	↑	34.0	9,598
12A35	24.8%	↑	↑	↑	20.0	129,826
12A36	24.8%	↑	↑	↑	20.0	336,088
12A37	32.8%	↑	↑	↑	14.0	207,655
12A38	32.8%	↑	↑	↑	14.0	105,117
12A39	32.8%	↓	↓	↓	20.0	43,974
12A40	32.8%	Yes	Yes	Yes	20.0	22,496

*Did not fail

TABLE 3-3. CRACK INITIATION TEST RESULTS FOR 7075-T6XX

SPECIMEN ID	LOAD TRANSFER	INTER-FERENCE	CLAMP-UP	SEALANT	σ_{max} (KSI)	CYCLES TO FAILURE
17A01	Open Hole	No	No	No	34.0	6,733
17A02	↑	↑	↑	↑	34.0	6,138
17A03	↓	↑	↑	↑	28.0	12,329
17A04	↓	↑	↑	↑	28.0	18,122
17A05	↓	↑	↑	↑	16.0	9,144
17A06	↓	↑	↑	↑	16.0	11,284
17A07	↓	↑	↑	↑	20.0	3,543
17A08	Open Hole	↑	↑	↑	20.0	1,583
17A09	8.4%	↑	↑	↑	18.0	110,033
17A10	8.4%	↑	↑	↑	18.0	51,746
17A11	29.2%	↑	↑	↑	32.0	4,577
17A12	29.2%	↑	↑	↑	32.0	2,913
17A13	4.1%	↑	↑	↑	25.0	1,087
17A14	4.1%	↑	↑	↑	25.0	958
17A15	32.8%	↓	↑	↑	20.0	24,795
17A16	32.8%	No	↑	↑	20.0	37,898
17A17	0	Yes	↑	↑	34.0	105,463*
17A18	0	↑	↑	↑	34.0	82,670
17A19	0	↑	↑	↑	18.0	94,630
17A20	0	↑	↑	↑	18.0	13,661
17A21	24.8%	↑	↑	↑	16.0	152,043
17A22	24.8%	↑	↑	↑	16.0	183,444
17A23	26.7%	↑	↓	↑	20.0	5,575
17A24	26.7%	↑	No	↑	20.0	4,140
17A25	8.4%	↑	Yes	↑	34.0	10,034
17A26	8.4%	↑	↑	↑	34.0	11,725
17A27	29.2%	↑	↑	↑	24.0	30,414
17A28	29.2%	↑	↑	↑	24.0	19,220
17A29	9.1%	↑	↑	↑	22.0	7,269
17A30	9.1%	↑	↑	↑	22.0	4,140
17A31	32.8%	↑	↑	↓	20.0	485,555
17A32	32.8%	↑	↑	No	20.0	101,265
17A33	24.8%	↑	↑	Yes	34.0	7,034
17A34	24.8%	↑	↑	↑	34.0	5,977
17A35	24.8%	↑	↑	↑	20.0	48,168
17A36	24.8%	↑	↑	↑	20.0	63,417
17A37	32.8%	↑	↑	↑	14.0	19,146
17A38	32.8%	↑	↑	↑	14.0	17,051
17A39	32.8%	↓	↓	↓	20.0	107,842
17A40	32.8%	Yes	Yes	Yes	20.0	101,266

*Did not fail

TABLE 3-4. SUMMARY OF CRACK INITIATION DATA FOR 2024-T3XX

GROUP	LOAD TRANSFER	HOLE CONDITION			CLAMP- UP	SEAL- ANT	Ksi σ_o	k_t	k_N	S	AVERAGE 2 SPECIMENS
		OPEN HOLE	FILLED HOLE								N_t TEST LIFE
			INTER- FERENCE	CLEAR- ANCE							
A	None	X			No	No	34.0	3.1	2.48	0.33	11,225
	None	X			No	No	28.0	3.1	2.48	0.23	20,956
	None	X			No	No	16.0	6.47	4.85	0.28	7,872
	None	X			No	No	20.0	6.47	4.85	0.44	3,970
	8.4%			X	No	No	18.0	3.4	2.70	0.11	*
	29.2%			X	No	No	32.0	4.38	3.39	0.55	8,649
	9.1%			X	No	No	25.0	6.96	5.2	0.79	1,451
	32.8%			X	No	No	20.0	8.00	5.93	0.66	3,790
B	None		X		No	No	34.0	3.1	2.48	0.33	84,050
	None		X		No	No	18.0	6.47	4.85	0.36	14,570
	24.8%		X		No	No	16.0	4.0	3.11	0.11	84,648
	26.7%		X		No	No	20.0	7.71	5.73	0.61	10,427
C	8.4%		X		Yes	No	34.0	2.4	2.70	0.39	19,044
	29.2%		X		Yes	No	24.0	4.38	3.39	0.31	71,972
	9.1%		X		Yes	No	22.0	6.96	5.2	0.61	30,313
	32.8%		X		Yes	No	20.0	8.00	5.93	0.66	20,715
D	24.8%		X		Yes	Yes	34.0	4.0	3.11	0.52	16,216
	24.8%		X		Yes	Yes	20.0	4.0	3.11	0.18	232,957
	32.8%		X		Yes	Yes	14.0	8.0	5.93	0.32	156,386
	32.8%		X		Yes	Yes	20.0	8.0	5.93	0.66	32,235

*ONE SPECIMEN DID NOT FAIL

TABLE 3-5. SUMMARY OF CRACK INITIATION DATA FOR 7075-T6XX

GROUP	LOAD TRANSFER	HOLE CONDITION			CLAMP- UP	SEAL- ANT	ksi σ_o	k_t	k_N	S	AVERAGE 2 SPECIMENS
		OPEN HOLE	FILLED HOLE								N_t TEST LIFE
			INTER- FERENCE	CLEAR- ANCE							
A	None	X			No	No	34.0	3.1	2.58	0.38	6,085
	None	X			No	No	28.0	3.1	2.58	0.26	15,225
	None	X			No	No	16.0	6.47	5.12	0.33	10,214
	None	X			No	No	20.0	6.47	5.12	0.52	2,563
	8.4%			X	No	No	18.0	3.4	2.81	0.13	80,890
	29.2%			X	No	No	32.0	4.38	3.55	0.64	3,745
	9.1%			X	No	No	25.0	6.96	5.48	0.93	1,022
	32.8%			X	No	No	9.5	8.00	6.27	0.17	31,346
B	None		X		No	No	34.0	3.1	2.48	0.38	94,066
	None		X		No	No	18.0	6.47	5.12	0.42	91,936
	24.8%		X		No	No	16.0	4.0	3.26	0.13	118,926
	26.7%		X		No	No	20.0	7.71	6.05	0.72	6,421
C	8.4%		X		Yes	No	34.0	3.4	2.81	0.45	11,784
	29.2%		X		Yes	No	24.0	4.38	3.55	0.36	22,922
	9.1%		X		Yes	No	22.0	6.96	5.48	0.72	13,840
	32.8%		X		Yes	No	9.5	8.00	6.27	0.17	374,502
D	24.8%		X		Yes	Yes	34.0	4.0	3.26	0.61	7,982
	24.8%		X		Yes	Yes	20.0	4.0	3.26	0.21	51,427
	32.8%		X		Yes	Yes	14.0	8.00	6.27	0.38	25,328
	32.8%		X		Yes	Yes	9.5	8.00	6.27	0.17	225,088

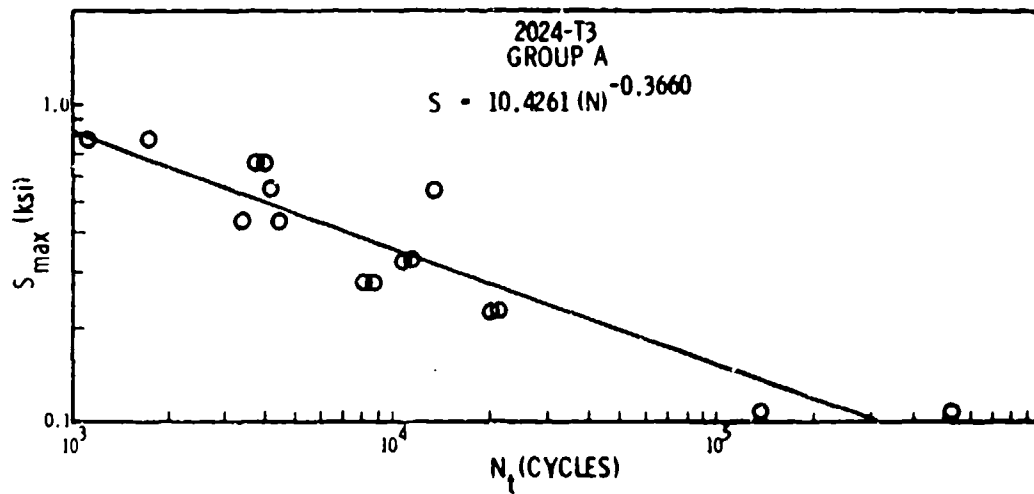


Figure 3-6. S vs N_f Data for 2024-T3 Group A Specimens

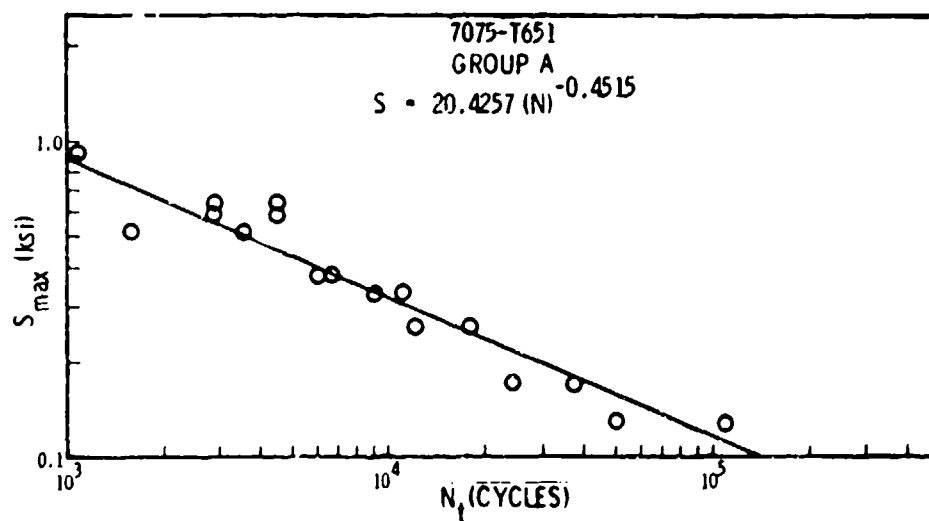


Figure 3-7. S vs N_f Data for 7075-T651 Group A Specimens

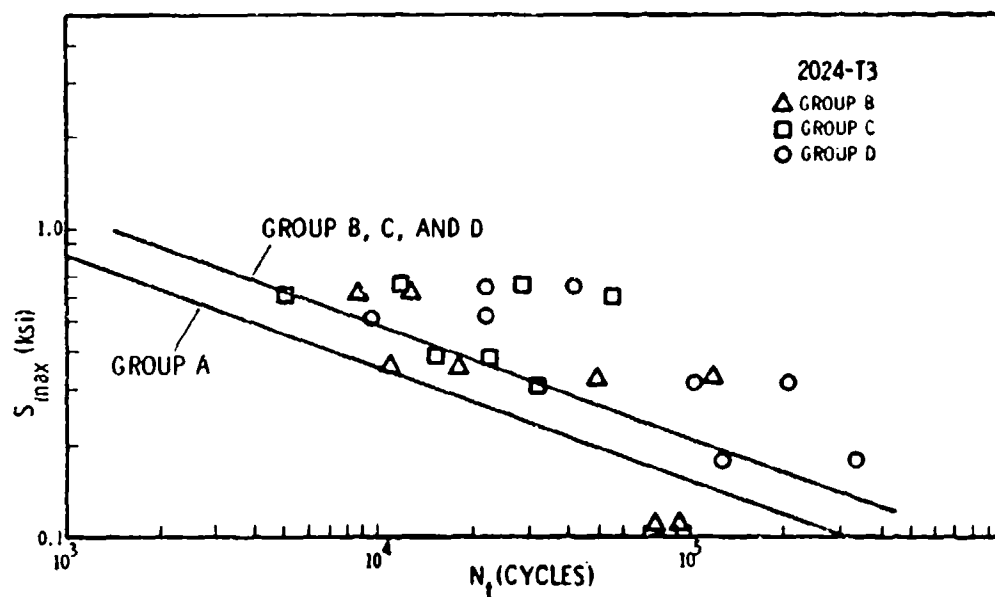


Figure 3-8. S vs N_f Data for 2024-T3 Groups B, C and D Specimens

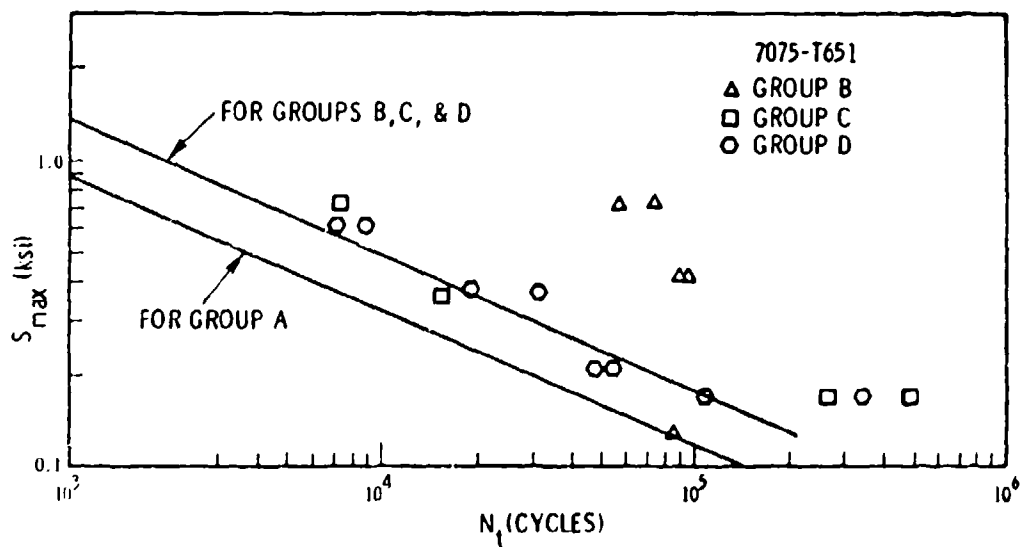


Figure 3-9. S vs N_f Data for 7075-T651 Groups B, C and D Specimens

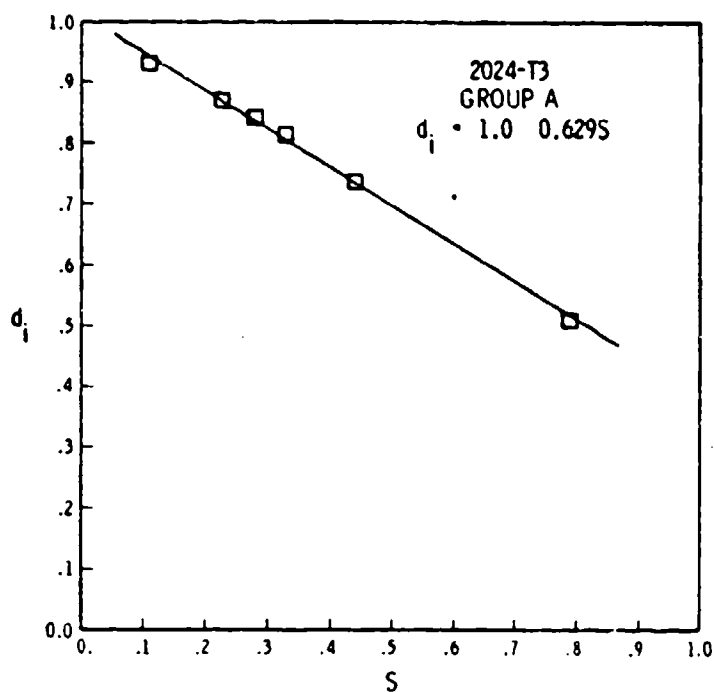


Figure 3-10. d_i vs S Data for 2024-T3 Group A Specimens

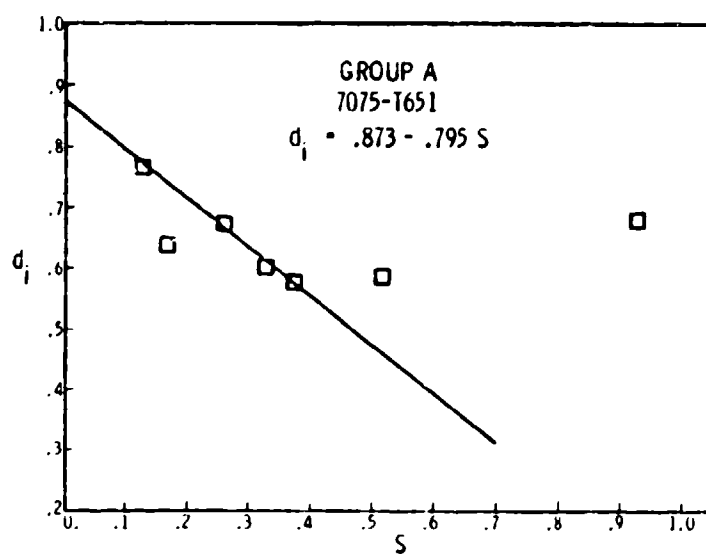


Figure 3-11. d_i vs S Data for 7075-T651 Group A Specimens

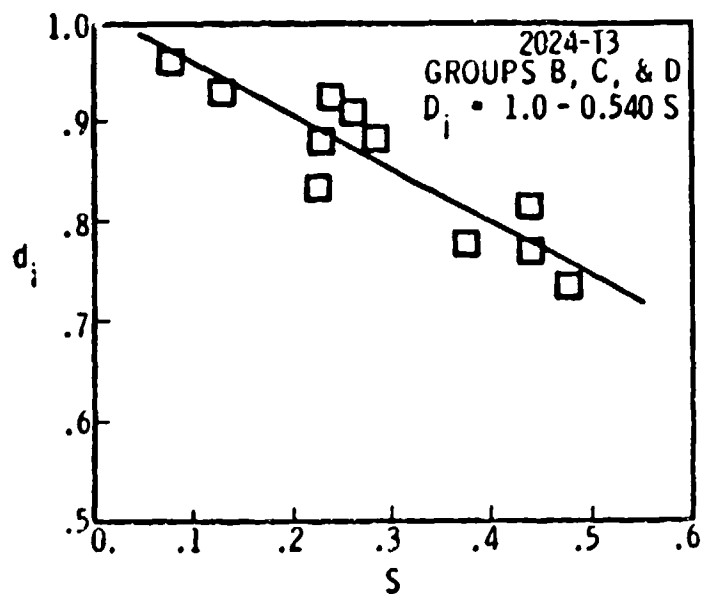


Figure 3-12. d_i vs S Data for 2024-T3 Groups B, C and D Specimens

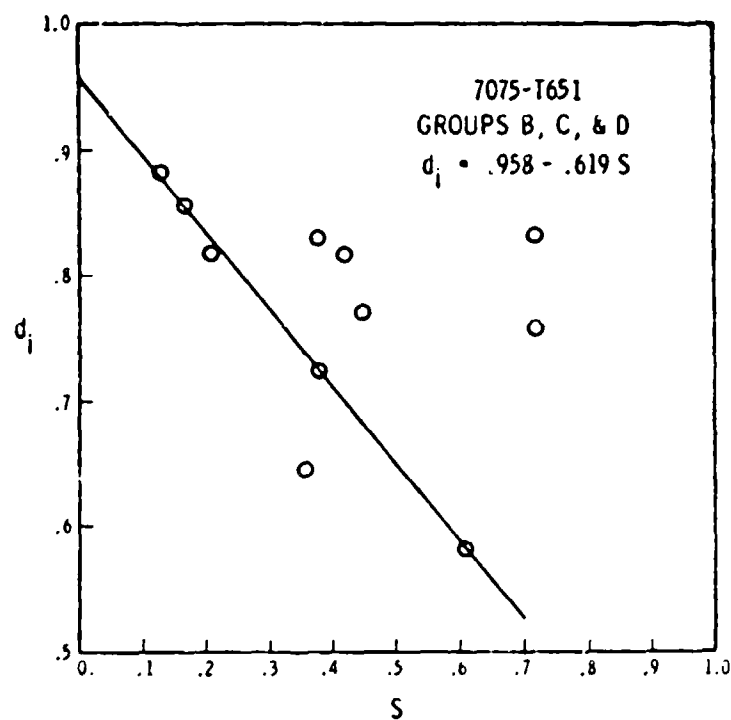


Figure 3-13. d_i vs S Data for 7075-T651 Groups B, C and D Specimens

4.0 FRACTURE TOUGHNESS TEST PROGRAM

The purpose of the fracture toughness test program was to establish fracture toughness allowables for the material form used during the structural test program defined in Task IV. The test included an evaluation of the critical fracture toughness factor ' K_{app} ' and the construction of the resistance curves (R-Curves). The test procedure and data reduction were performed in compliance with ASTM E561.

4.1 TEST SPECIMENS

Twenty (20) center crack tension (CCT) specimens were tested. The materials selected were "2024-T3XX" and "7075-T6XX" aluminum alloys in various product form as shown in Figures 4-1 through 4-4. The material type and product form was consistent with the type used during the structural test program. The specimens were fabricated from sheet, plate, extruded angle and extruded 'Tee' section. The initial flaws were introduced at the mid section of each specimen by a sawcut followed by the application of constant amplitude loading. The magnitude of the maximum load did not exceed 40% of the yield value based on net section. The loading continued until crack propagation of 0.050 in. at each side of the initial sawcut was achieved. The size of the crack at the start of the fracture toughness test was within 30 to 40 percent of the specimen width.

4.2 TEST ENVIRONMENT

The fracture toughness test program was conducted under controlled lab-air environment, at FRC testing laboratories located in Farmingdale, N.Y.

4.3 LOADING

Constant amplitude loading was initially applied to obtain a sharp initial crack. The magnitude of the load was set to 40% of the yield stress based on net section. During the fracture toughness test phase, the load was incrementally increased until fast fracture was achieved. Measurement of the crack opening was obtained using a crack opening gage installed at the crack mid section. This data was used to determine the fracture resistance curves (R-Curves).

4.4 TEST RESULTS

The test results of twenty (20) fracture toughness specimens are summarized in Table 4-1. In general the sheet material exhibited higher fracture toughness than the extruded material for 2024-T3 and 7075-T6 aluminum alloy. The critical fracture toughness was evaluated for each specimen in terms of apparent fracture toughness K_{app} using the equation:

$$K_{APP} = \frac{P_{max}}{WB} \left(\pi a_o \left(\sec \frac{\pi a_o}{W} \right) \right)^{1/2}$$

Where ' P_{max} ' is the maximum applied load recorded just before specimen failure and ' a_o ' is the initial half crack length at the start of the specimen loading.

The Raw Test Data are presented in Figures 4-5 through 4-24. It includes initial specimen configuration and crack opening displacement vs. applied load. This data were reduced (Ref. Volume III) to obtain R-Curves for the material in question.

TABLE 4-1. FRACTURE TOUGHNESS TEST DATA

SPECIMEN I.D.	MATERIAL	THICKNESS (in.)	WIDTH (in.)	a_0 (in.)	P_{max} (kip)	K_{app} (ksi \sqrt{in})
1B	2024-T3 Sheet	0.193	12.0	1.875	74.00	82.45
1C	2024-T3 Sheet	0.193	12.0	1.870	75.00	83.55
3A	2024-T3 Sheet	0.088	18.0	2.750	50.00	98.51
3C	2024-T3 Sheet	0.088	18.0	2.767	50.25	99.39
5A	2024-T351 Plate	0.253	8.0	1.285	71.50	75.86
5C	2024-T351 Plate	0.253	8.0	1.295	71.25	75.97
7A	2024-T3511 Tee	0.188	2.75	0.487	17.00	44.16
7B	2024-T3511 Tee	0.187	2.75	0.485	16.75	43.59
9A	2024-T3411 Angle	0.236	2.25	0.425	18.75	44.81
9B	2024-T3411 Angle	0.240	2.25	0.425	18.25	42.89
11A	7075-T6 Plate	0.325	3.0	0.520	34.75	49.25
11B	7075-T651 Plate	0.323	3.0	0.522	31.80	45.49
13B	7075-T651 Plate	0.406	3.0	0.535	34.50	39.89
13C	7075-T651 Plate	0.406	3.0	0.525	37.00	42.25
15B	7075-T6 Sheet	0.157	12.0	1.870	59.75	81.82
15C	7075-T6 Sheet	0.156	12.0	1.895	59.50	82.69
17B	7075-T6511 Tee	0.301	2.75	0.485	34.90	56.44
17C	7075-T6511 Tee	0.298	2.75	0.510	32.50	54.93
19A	7075-T6511 Angle	0.311	2.75	0.475	32.50	50.16
19B	7075-T6511 Angle	0.310	2.75	0.522	32.25	53.29

MATERIAL	THICKNESS (IN)
2024-T3511 Angle	0.190
7075-T6511 Tee	0.300
7075-T6511 Angle	0.310

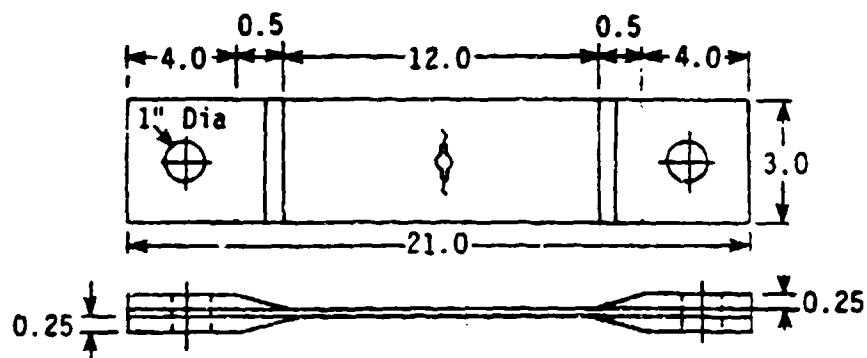


Figure 4-1. 'CCT' K_{IC} Specimen 3.0" Wide

MATERIAL	THICKNESS (IN)
2024-T3511 Angle	0.250

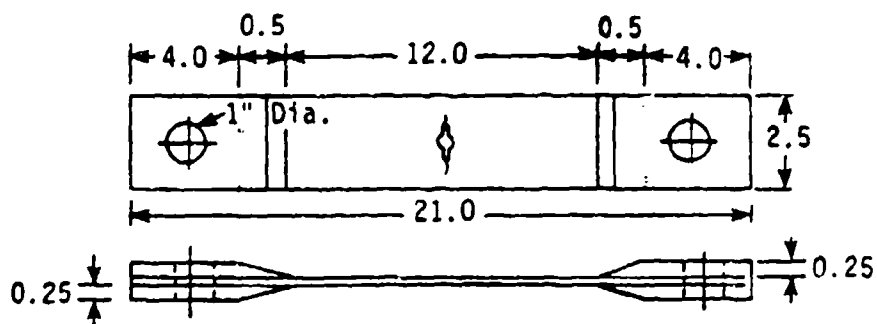


Figure 4-2. 'CCT' K_{IC} Specimens 2.5" Wide

MATERIAL	THICKNESS (IN)
2024-T3 Sheet	0.090
2024-T3 Sheet	0.190
7075-T6 Sheet	0.160

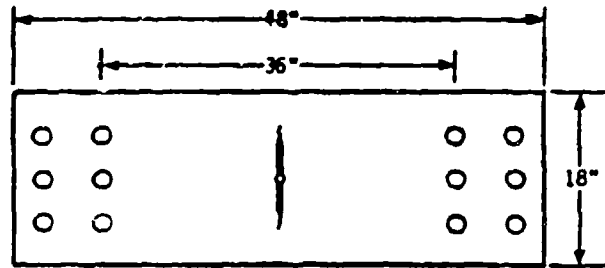


Figure 4-3. 'CCT' K_{IC} Specimen 18" Wide

MATERIAL	THICKNESS (IN)
2024-T351 Plate	0.25
7075-T651 Plate	0.31
7075-T651 Plate	0.42

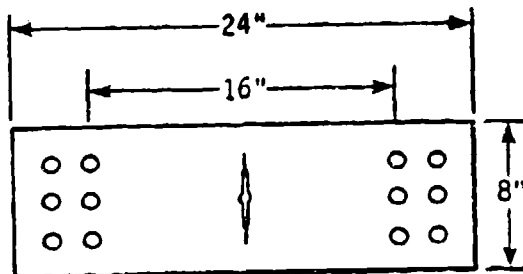
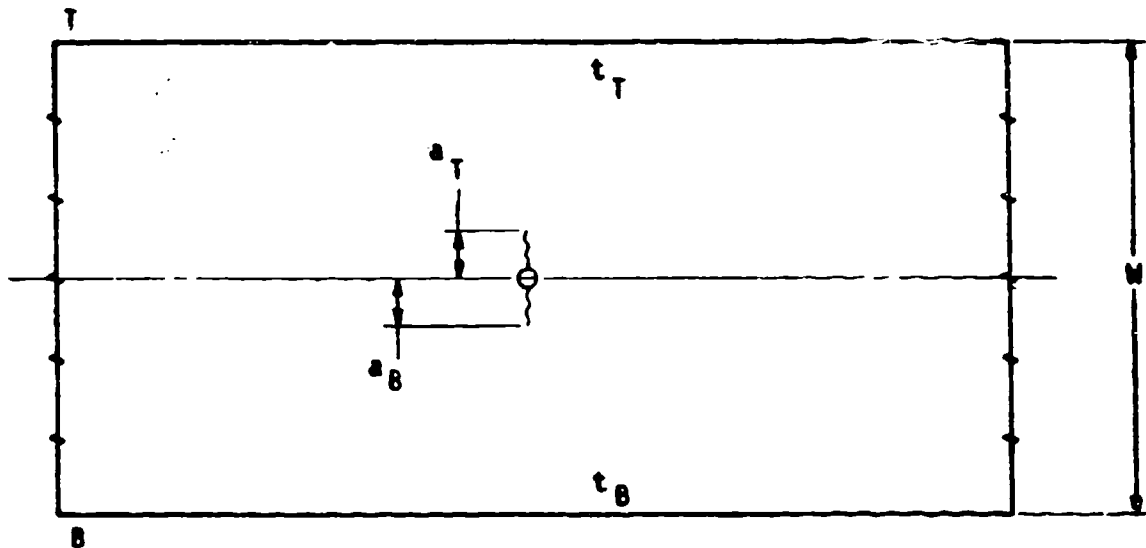


Figure 4-4. 'CCT' K_{IC} Specimen 8" Wide

SPECIMEN NO. GT160KAB51-1B

MAT'L — 2024-T3



SPECIMEN MEASUREMENTS

$W = 12 \text{ in.}$
 $t_T = 0.1926 \text{ in.}$
 $t_B = 0.1940 \text{ in.}$

$a_T = 1.810 \text{ in.}$
 $a_B = 1.780 \text{ in.}$
 $a_0 = 1.875 \text{ in.}$

PRECRACK DATA

NET AREA = 1.6257 in.^2

$P_{\max} = 30,000 \text{ lbs}$
 $P_{\min} = 3,000 \text{ lbs}$

LEFT = $0.060/0.060 \text{ in.}$
 RIGHT = $0.050/0.078 \text{ in.}$
 No of cycles = 1829

FAILURE LOAD AFTER
 PRE-CRACKING
 $P = 74,000 \text{ lbs}$

Figure 4-5A. Fracture Toughness Data Sheet GT160KAB51-1B

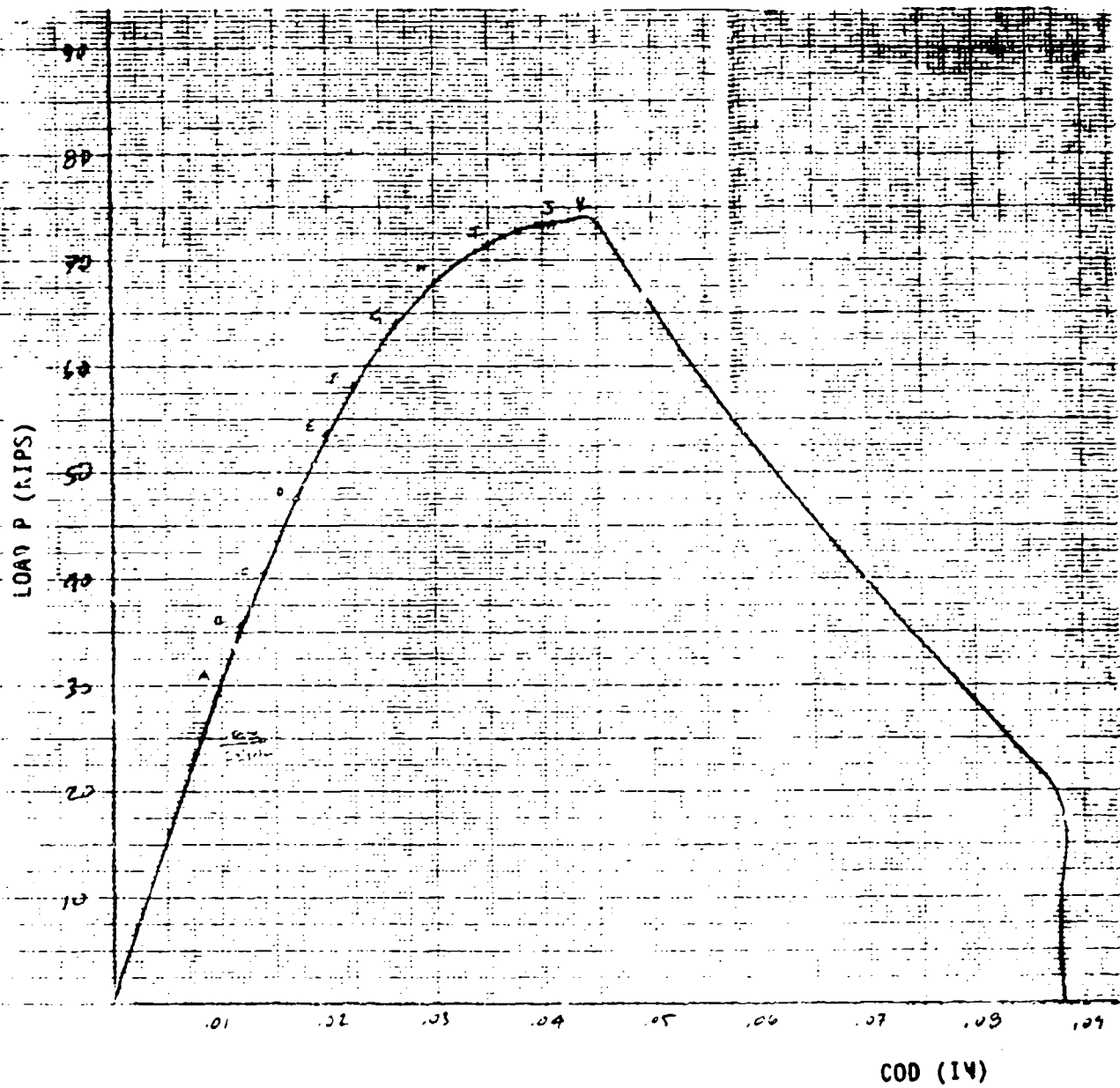
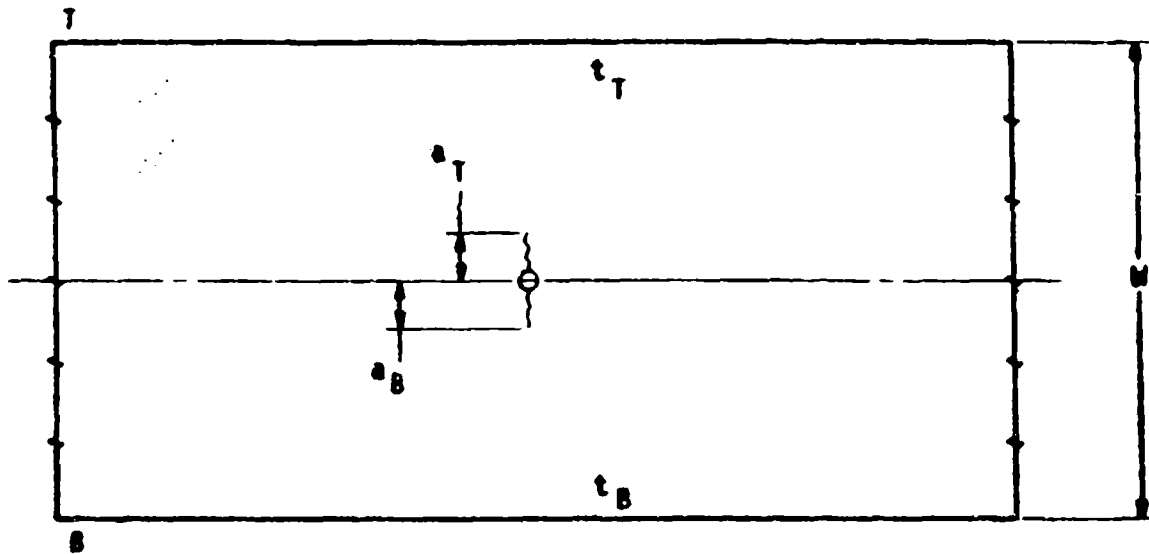


Figure 4-5B. Applied Load vs. Crack Opening Displacement GT160KAB51-18

SPECIMEN NO. GT160KAB51-1C

MAT'L — 2024-T3



SPECIMEN MEASUREMENTS

W = 12 in.
t_T = 0.1920 in.
t_B = 0.1939 in.

a_T = 1.790 in.
a_B = 1.790 in.

PRECRACK DATA

NET AREA = 1.6246 in.²

P_{max} = 30,000 lbs
P_{min} = 3,000 lbs

LEFT = 0.080/0.050 in.
RIGHT = 0.050/0.060 in.
No of cycles = 1712

FAILURE LOAD AFTER
PRE-CRACKING
P = 107,840 lbs

Figure 4-6A. Fracture Toughness Data Sheet GT160KAB51-1C

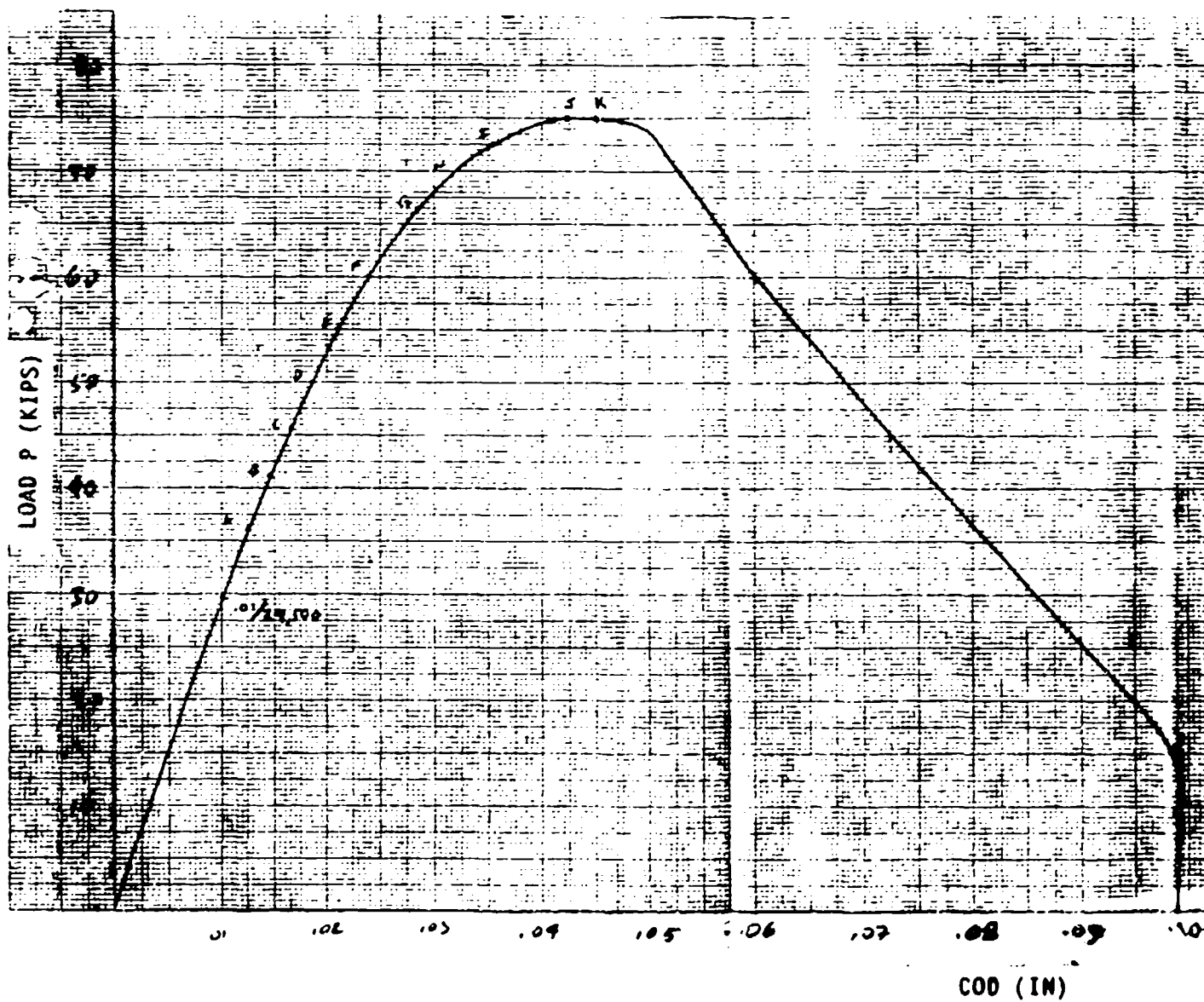
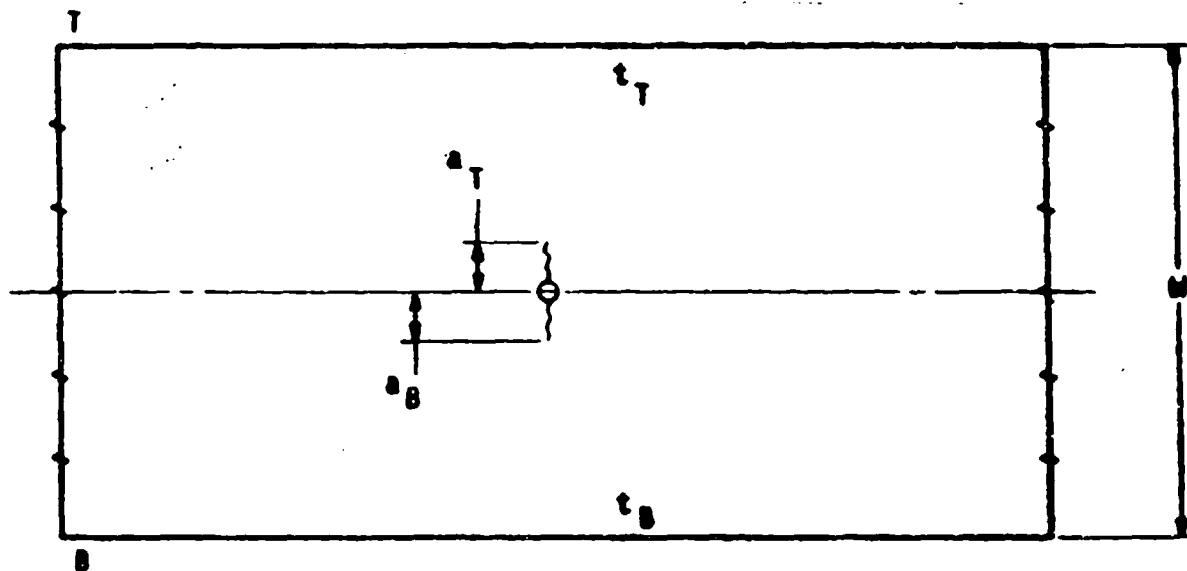


Figure 4-6B. Applied Load vs. Crack Opening Displacement GT160KAB51-1C

SPECIMEN NO. GT160KAB51-3A

MAT'L — 2024-T3



SPECIMEN MEASUREMENTS

$W = 18 \text{ in.}$
 $t_T = 0.088 \text{ in.}$
 $t_B = 0.088 \text{ in.}$

$a_T = 2.680 \text{ in.}$
 $a_B = 2.680 \text{ in.}$
 $a_0 = 2.75 \text{ in.}$

PRECRACK DATA

NET AREA = 1.112 in.^2

$P_{\max} = 21,000 \text{ lbs}$
 $P_{\min} = 2,100 \text{ lbs}$

LEFT = N/A
 RIGHT = N/A
 No of cycles = N/A

FAILURE LOAD AFTER
 PRE-CRACKING
 $P = 50,000 \text{ lbs}$

Figure 4-7A. Fracture Toughness Data Sheet GT160KAB51-3A

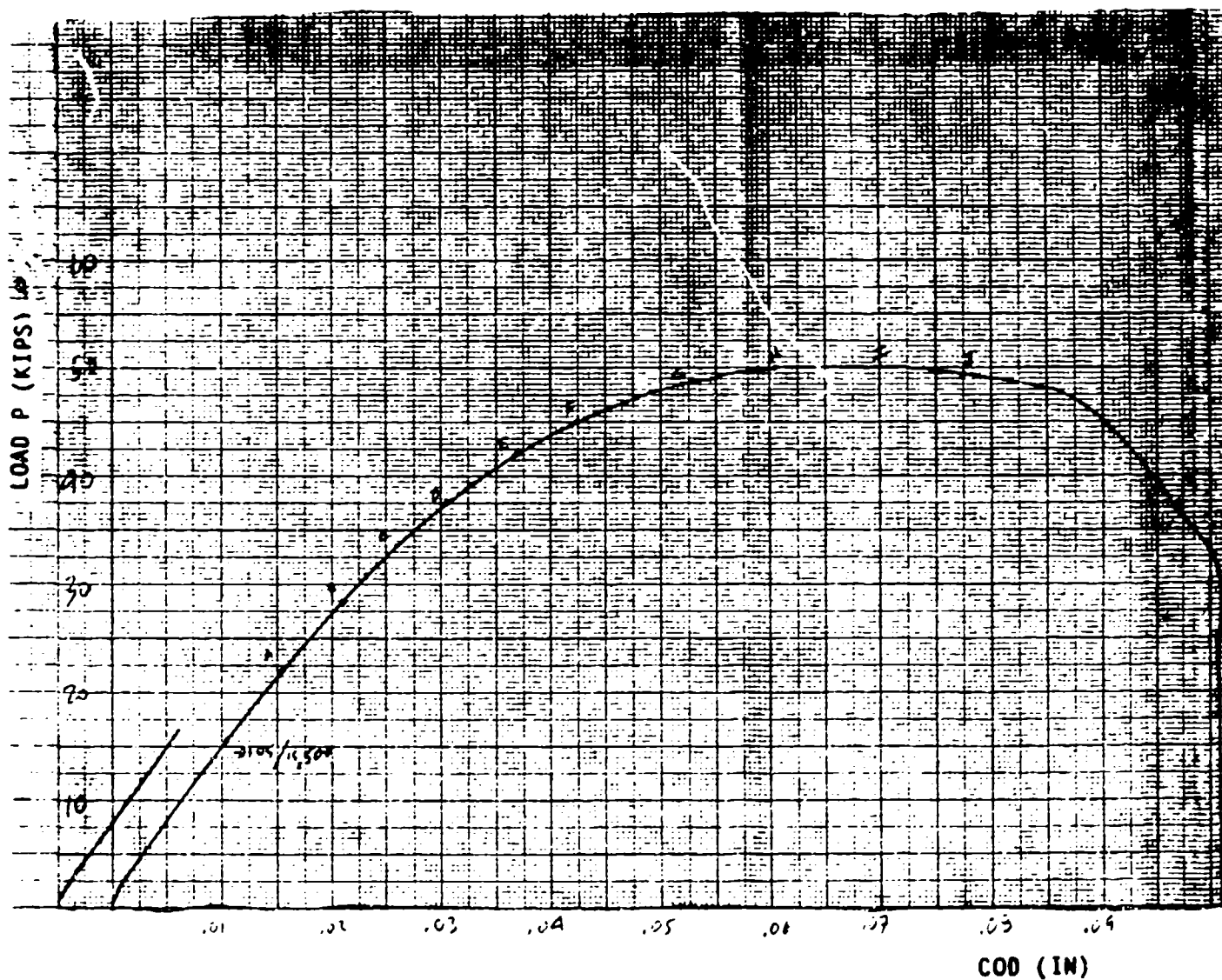
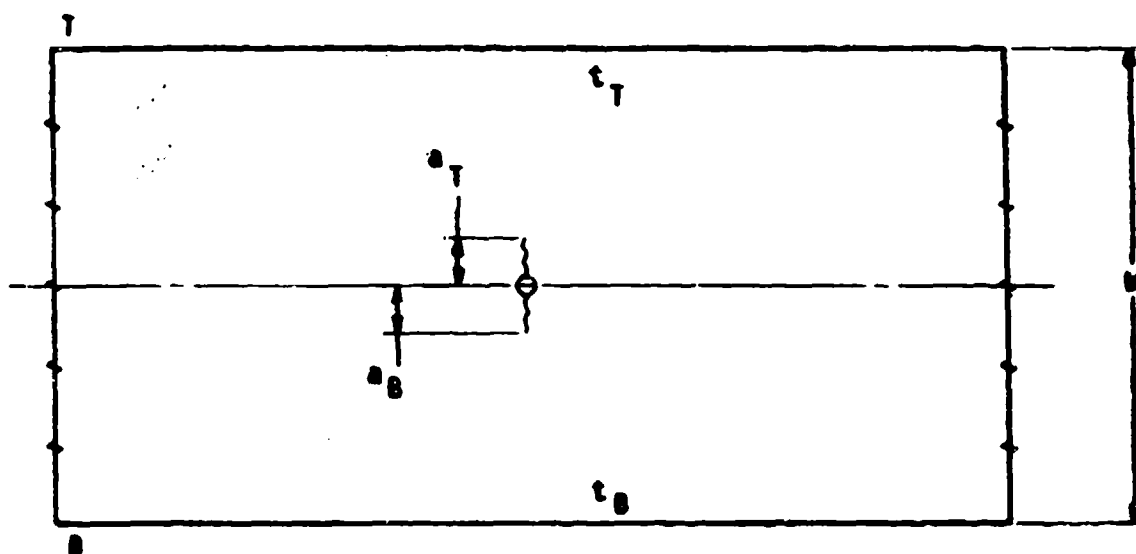


Figure 4-7B. Applied Load vs. Crack Opening Displacement GT160KAB51-3A

SPECIMEN MEASUREMENTS

$W = 18.00 \text{ in.}$
 $t_T = 0.088 \text{ in.}$
 $t_B = 0.088 \text{ in.}$

$a_T = 2.700 \text{ in.}$
 $a_B = 2.680 \text{ in.}$
 $a_0 = 2.767 \text{ in.}$

PRECRACK DATA

NET AREA = 1.111 in.^2

$P_{\max} = 21,000 \text{ lbs}$
 $P_{\min} = 2,100 \text{ lbs}$

LEFT = $0.060/0.080 \text{ in.}$
 RIGHT = $0.060/0.070 \text{ in.}$
 No of cycles = 1181

FAILURE LOAD AFTER
 PRE-CRACKING
 $P = 50,250 \text{ lbs}$

Figure 4-8A. Fracture Toughness Data Sheet GT160KAB51-3C

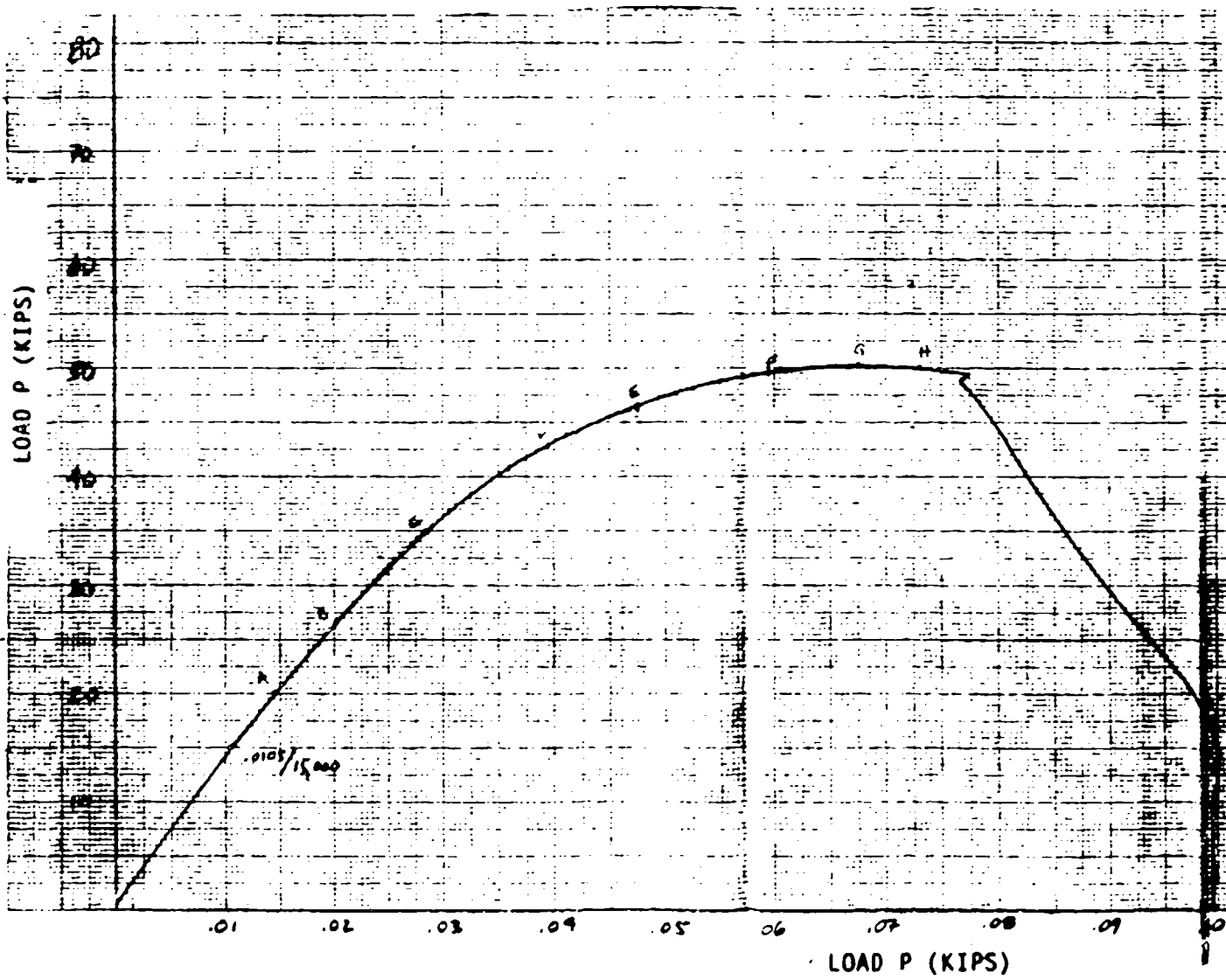
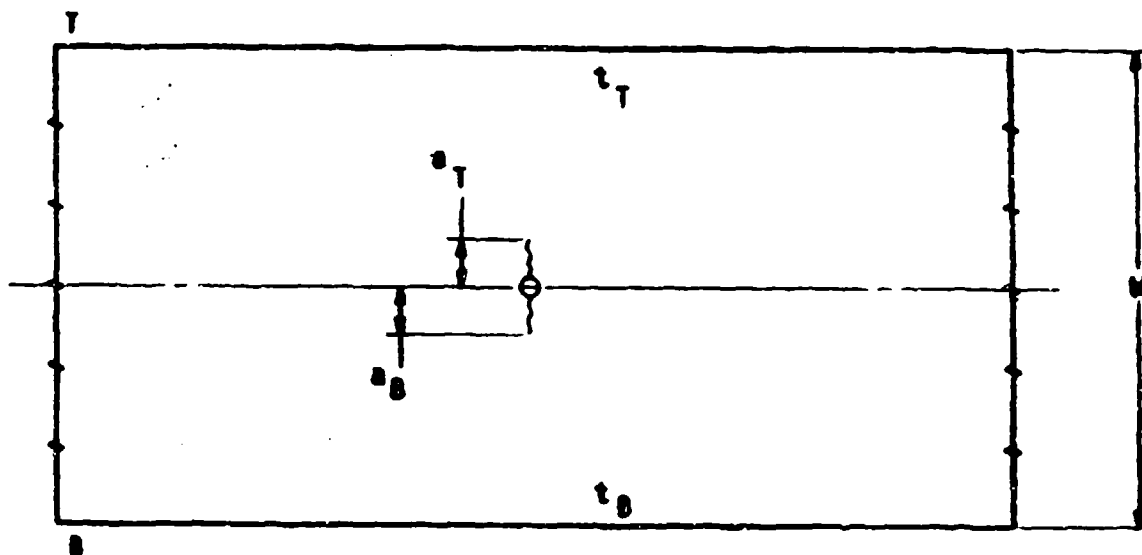


Figure 4-88. Applied Load vs. Crack Opening Displacement GT160KAB51-3C

SPECIMEN NO. GT160KAB51-5A

MAT'L — 2024-T351



SPECIMEN MEASUREMENTS

W = 8.00 in.
t_T = 0.2530 in.
t_B = 0.2523 in.

a_T = 1.190 in.
a_B = 1.200 in.
a₀ = 1.285 in.

PRECRACK DATA

NET AREA = 1.417 in.²

P_{max} = 26,000 lbs
P_{min} = 2,600 lbs

LEFT = 0.060/0.060 in.
RIGHT = 0.050/0.050 in.
No of cycles = 2500

FAILURE LOAD AFTER
PRE-CRACKING
P = 71,500 lbs

Figure 4-9A. Fracture Toughness Data Sheet GT160KAB51-5A

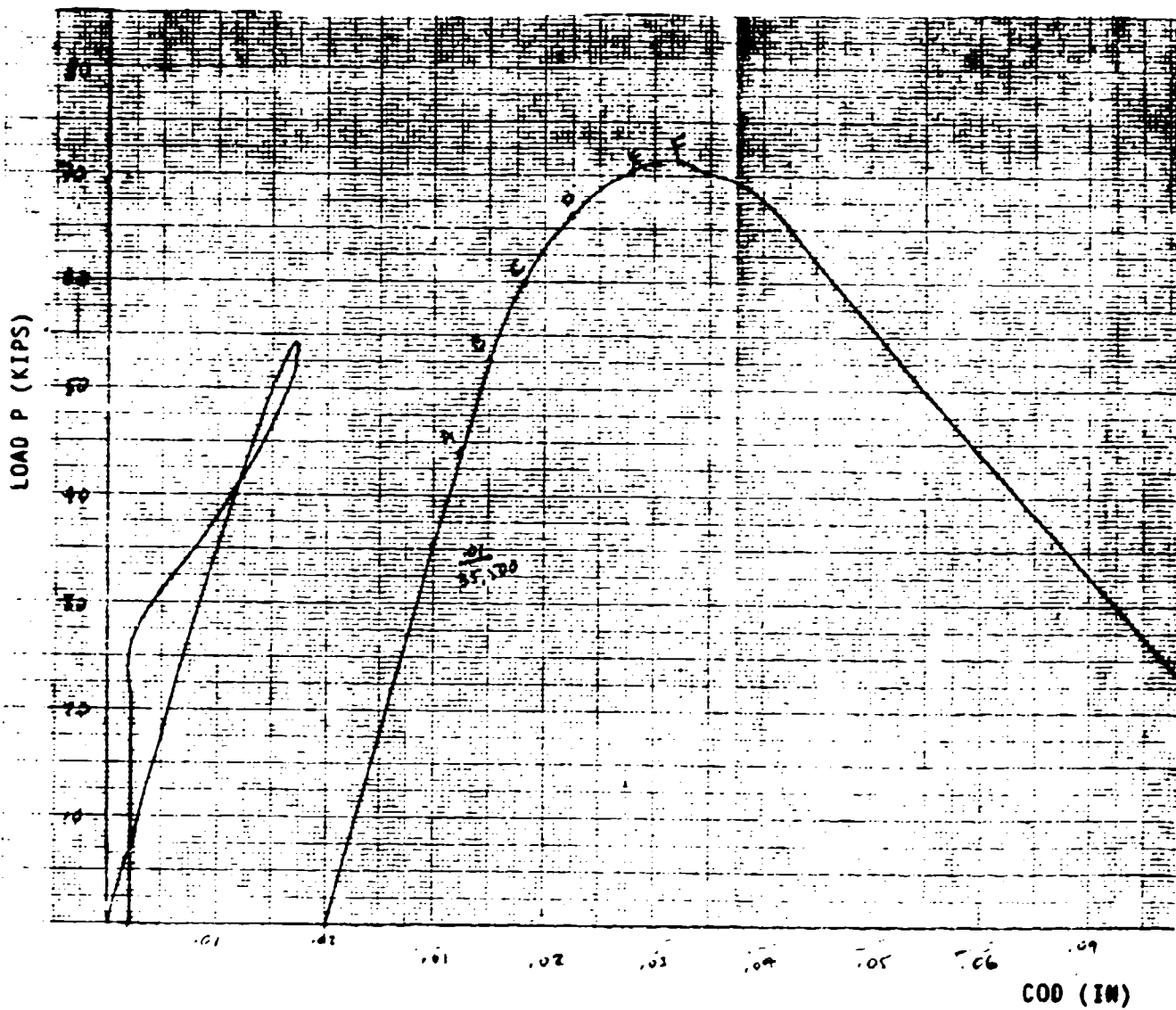
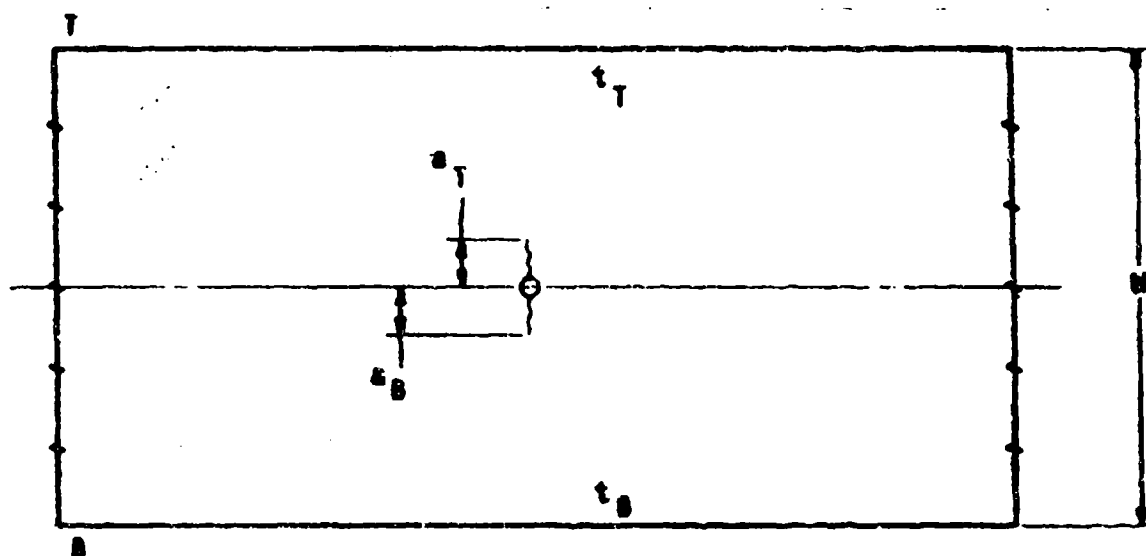


Figure 4-98. Applied Load vs. Crack Opening Displacement GT160KAB51-5A

SPECIMEN NO. GT160KAB51-5C

MAT'L --- 2024-T351



SPECIMEN MEASUREMENTS

W = 8.00 in.
t_T = 0.2530 in.
t_B = 0.2526 in.

a_T = 1.210 in.
a_B = 1.190 in.
a₀ = 1.295 in.

PRECRACK DATA

NET AREA = 1.416 in.²

P_{max} = 26,000 lbs
P_{min} = 2,600 lbs

LEFT = 0.050/0.050 in.
RIGHT = 0.060/0.060 in.
No of cycles = 2769

FAILURE LOAD AFTER
PRE-CRACKING
P = 71,250 lbs

Figure 4-10A. Fracture Toughness Data Sheet GT160KAB51-5C

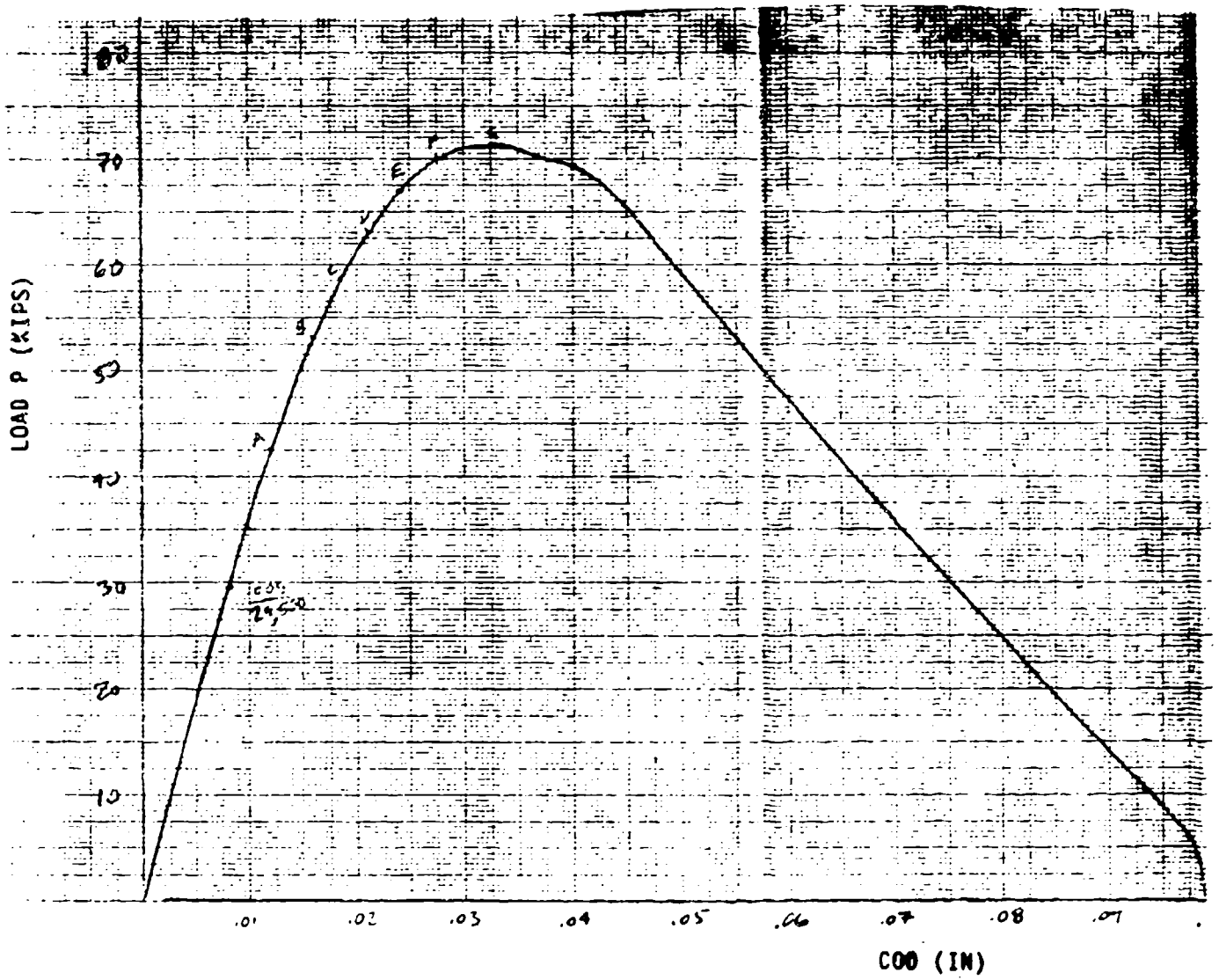
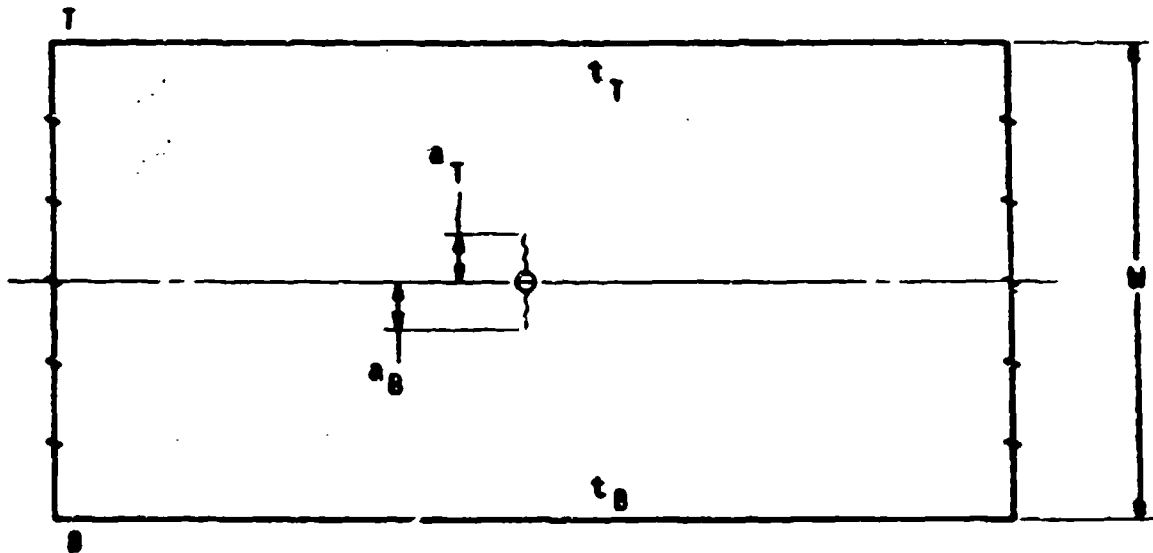


Figure 4-108. Applied Load vs. Crack Opening Displacement GT160KAB51-5C

SPECIMEN NO. GT160KAB51-7A

MAT'L — 2024-T3511 EXT.



SPECIMEN MEASUREMENTS

W = 2.75 in.
t_T = 0.1865 in.
t_B = 0.1880 in.

a_T = 0.405 in.
a_B = 0.410 in.
a₀ = 0.4875 in.

PRECRACK DATA

NET AREA = 0.3631 in.²

P_{max} = 6,100 lbs
P_{min} = 610 lbs

LEFT = 0.080/0.050 in.
RIGHT = 0.050/0.050 in.
No of cycles = 8095

FAILURE LOAD AFTER
PRE-CRACKING
P = 17,000 lbs

Figure 4-11A. Fracture Toughness Data Sheet GT160KAB51-7A

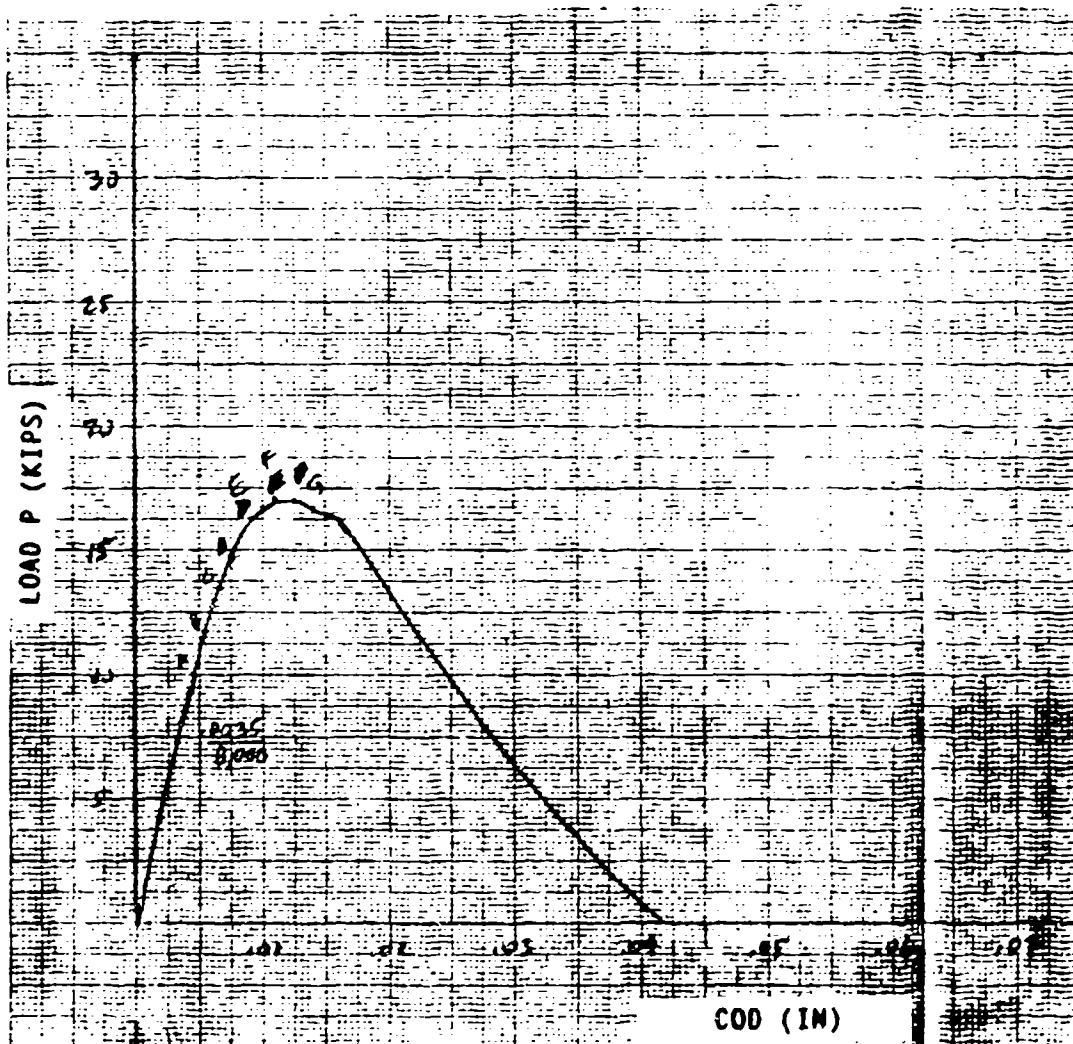
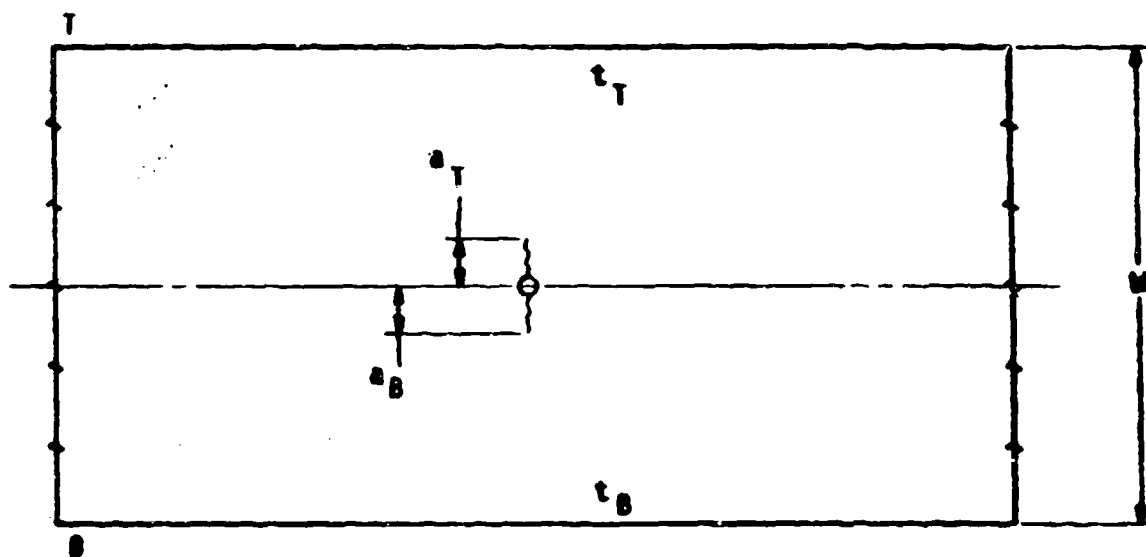


Figure 4-11B. Applied Load vs. Crack Opening Displacement GT160KAB51-7A

SPECIMEN NO. GT160KAB51-78

MAT'L — 2024-T3511 EXT.



SPECIMEN MEASUREMENTS

W = 2.749 in.
t_T = 0.1860 in.
t_B = 0.1886 in.

a_T = 0.410 in.
a_B = 0.430 in.
a₀ = 0.485 in.

PRECRACK DATA

NET AREA = 0.3576 in.²

P_{max} = 6,007 lbs
P_{min} = 600 lbs

LEFT = 0.050/0.070 in.
RIGHT = 0.050/0.055 in.
No of cycles = 14344

FAILURE LOAD AFTER
PRE-CRACKING
P = 16,750 lbs

Figure 4-12A. Fracture Toughness Data Sheet GT160KAB51-78

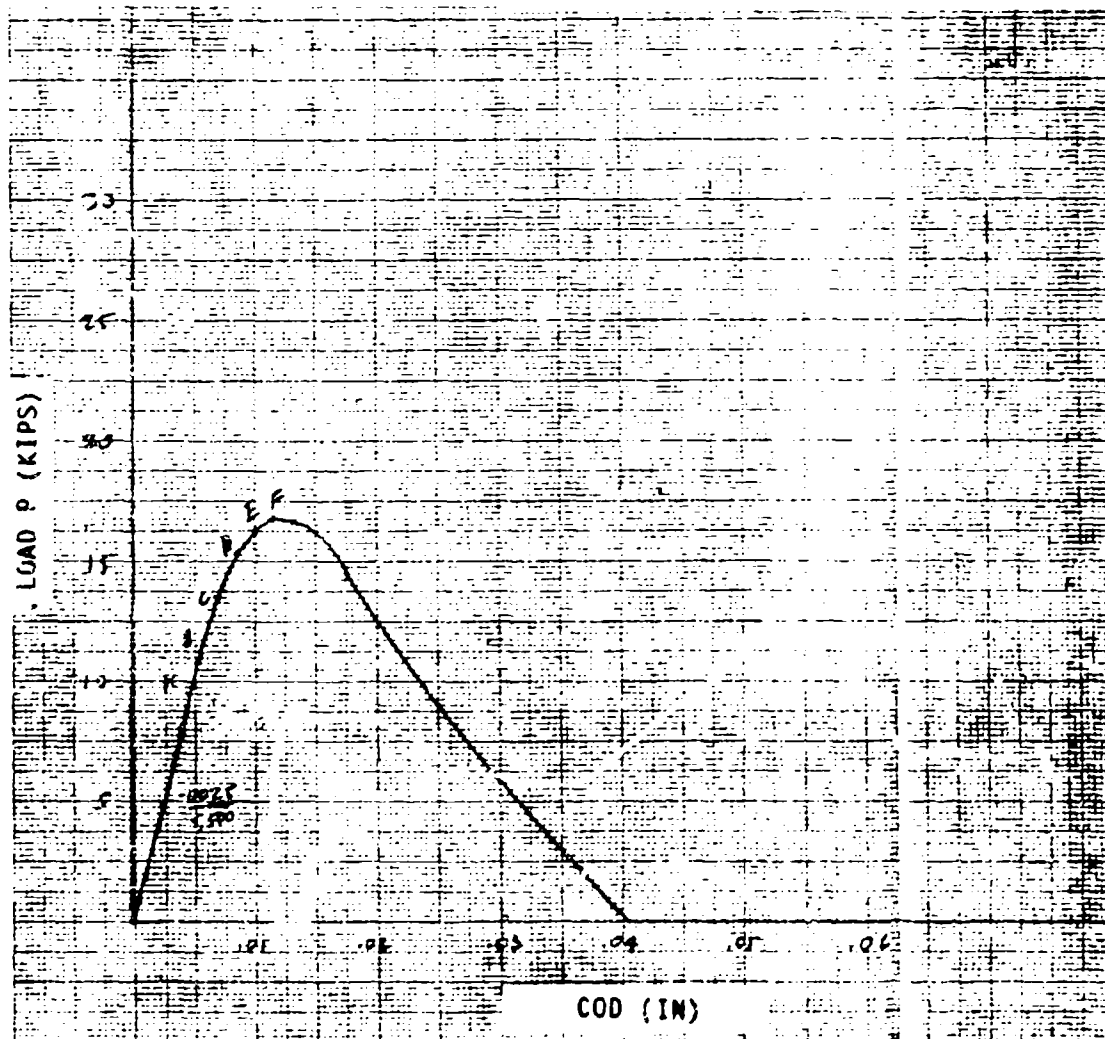
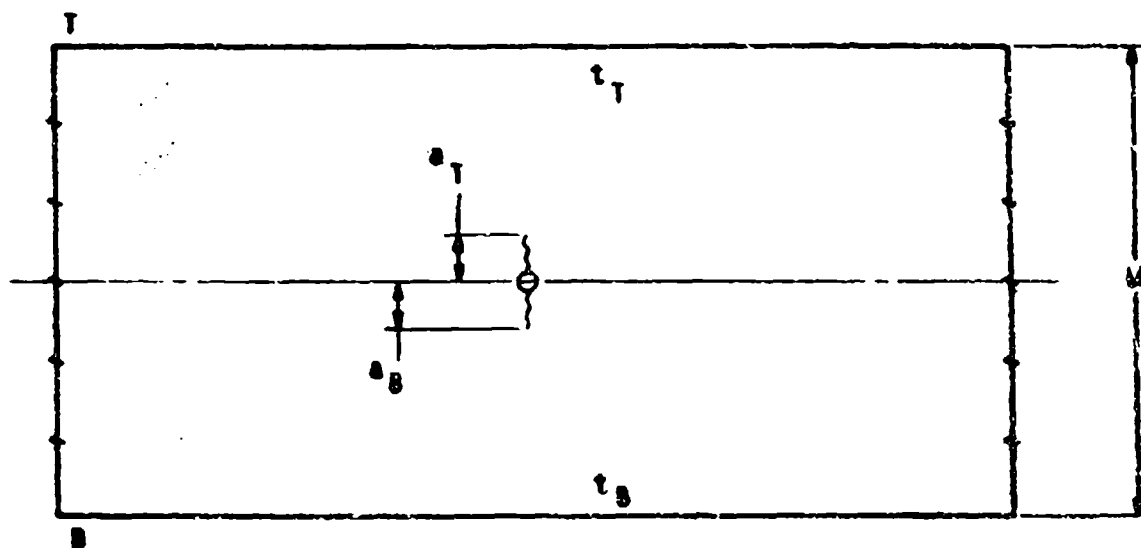


Figure 4-12B. Applied Load vs. Crack Opening Displacement GT160KAB51-78

SPECIMEN NO. GT160KAB51-9A

MAT'L — 2024-T3511 EXT.



SPECIMEN MEASUREMENTS

W = 2.259 in.
t_T = 0.230 in.
t_B = 0.242 in.

a_T = 0.350 in.
a_B = 0.350 in.
a₀ = 0.425 in.

PRECRACK DATA

NET AREA = 0.3679 in.²

P_{max} = 6,475 lbs
P_{min} = 648 lbs

LEFT = 0.090/0.090 in.
RIGHT = 0.050/0.055 in.
No of cycles = 14246

FAILURE LOAD AFTER
PRE-CRACKING
P = 18,750 lbs

Figure 4-13A. Fracture Toughness Data Sheet GT160KAB51-9A

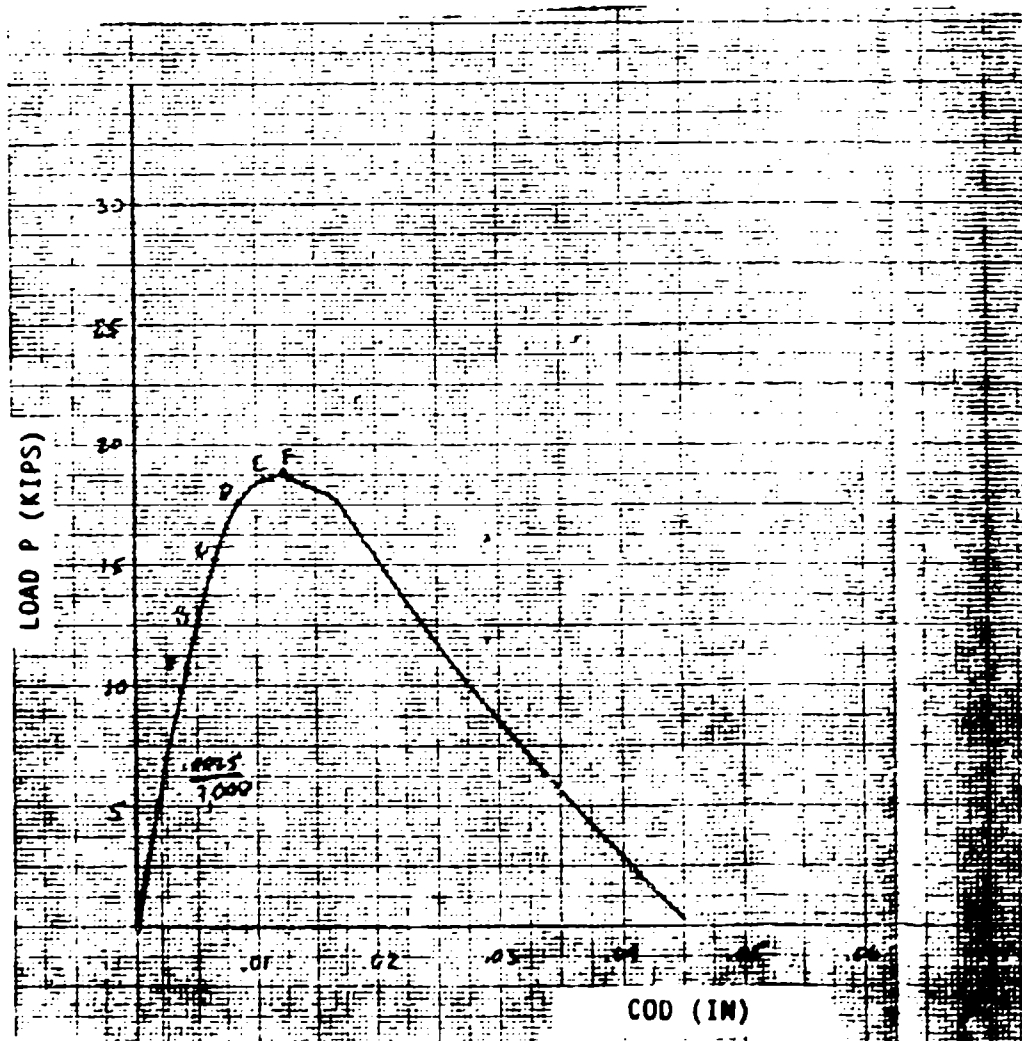
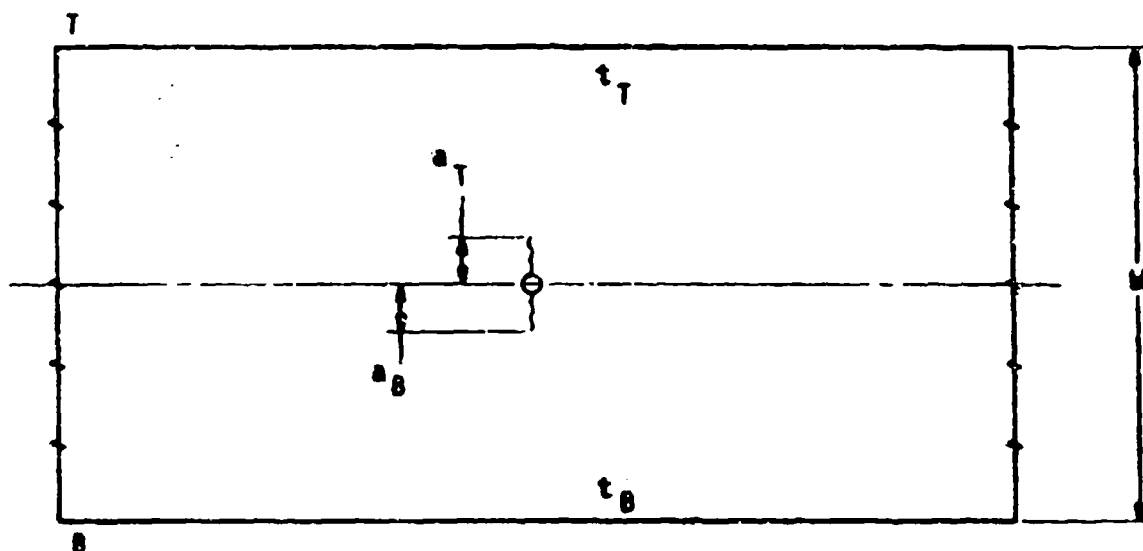


Figure 4-13B. Applied Load vs. Crack Opening Displacement GT160KAB51-9A

SPECIMEN NO. GT160KAB51-98

MAT'L — 2024-T3511 EXT.



SPECIMEN MEASUREMENTS

W = 2.258 in.
t_T = 0.2425 in.
t_B = 0.2370 in.

a_T = 0.340 in.
a_B = 0.350 in.
a₀ = 0.425 in.

PRECRACK DATA

NET AREA = 0.3759 in.²

P_{max} = 6,616 lbs
P_{min} = 662 lbs

LEFT = 0.055/0.055 in.
RIGHT = 0.070/0.070 in.
No of cycles = 15643

FAILURE LOAD AFTER
PRE-CRACKING
P = 18,250 lbs

Figure 4-14A. Fracture Toughness Data Sheet GT160KAB51-98

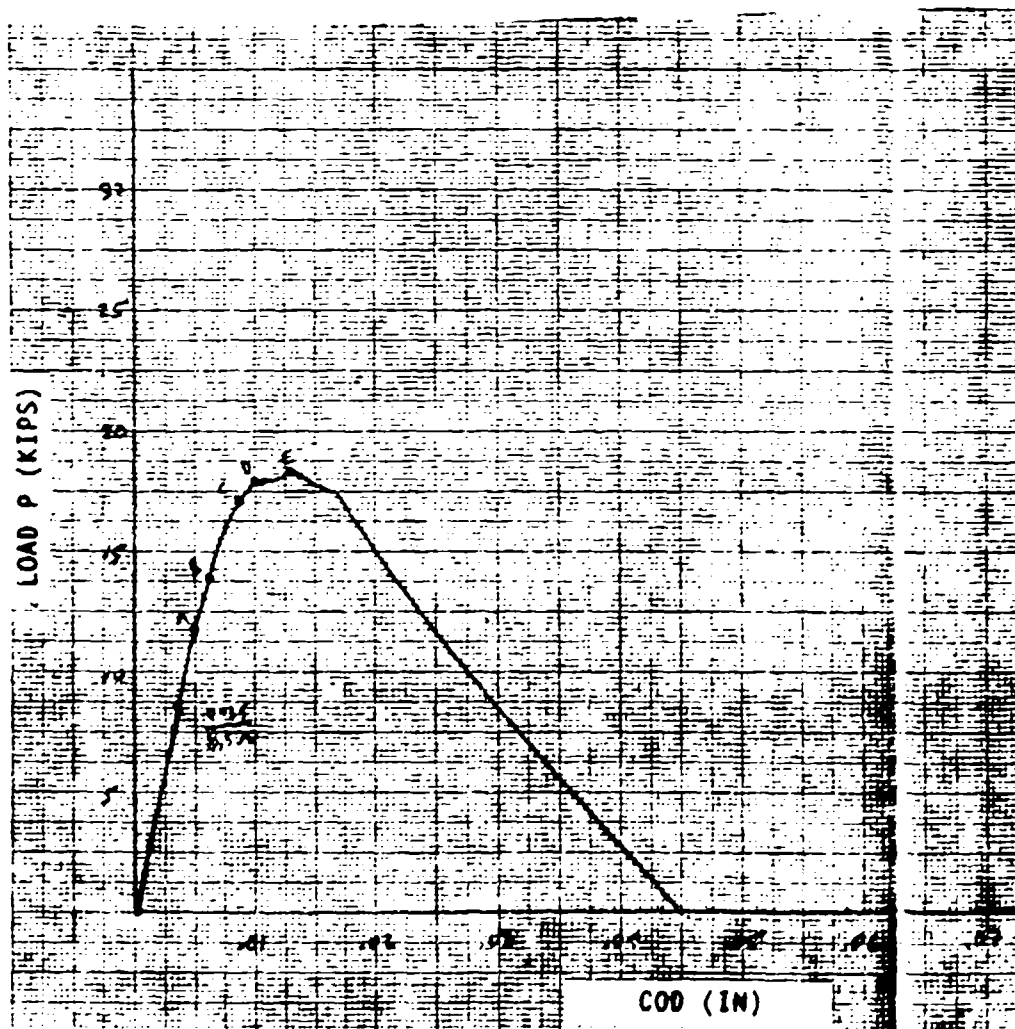
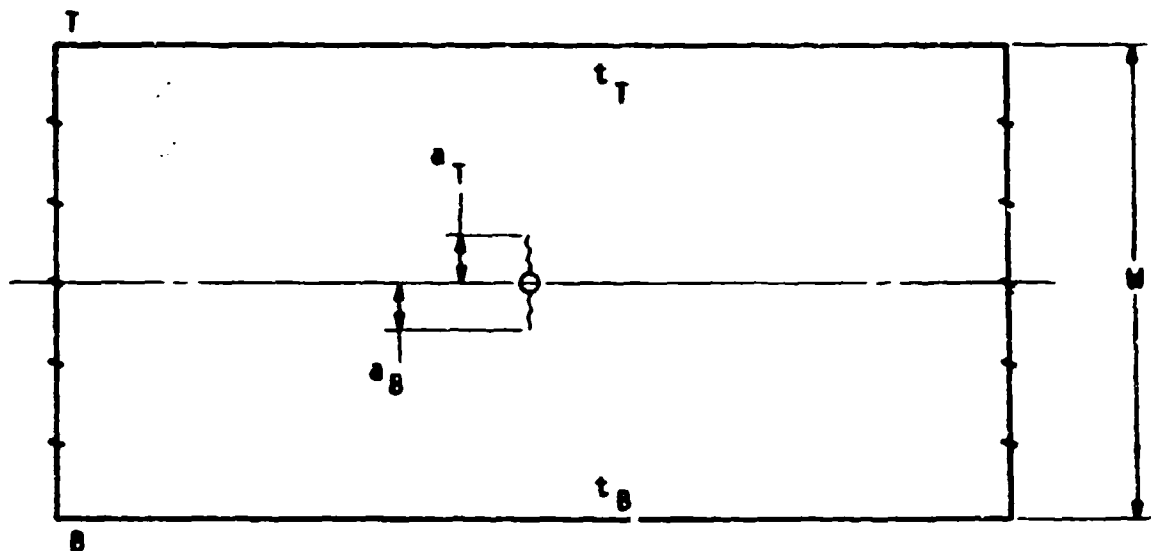


Figure 4-148. Applied Load vs. Crack Opening Displacement GT160KAB51-9B

SPECIMEN NO. GT160KAB51-11A

MAT'L — 7075-T651



SPECIMEN MEASUREMENTS

W = 3.000 in.
t_T = 0.3245 in.
t_B = 0.3245 in.

a_T = 0.450 in.
a_B = 0.440 in.
a₀ = 0.520 in.

PRECRACK DATA

NET AREA = 0.6847 in.²

P_{max} = 9,449 lbs
P_{min} = 945 lbs

LEFT = 0.050/0.078 in.
RIGHT = 0.050/0.068 in.
No of cycles = 8915

FAILURE LOAD AFTER
PRE-CRACKING
P = 34,750 lbs

Figure 4-15A. Fracture Toughness Data Sheet GT160KAB51-11A

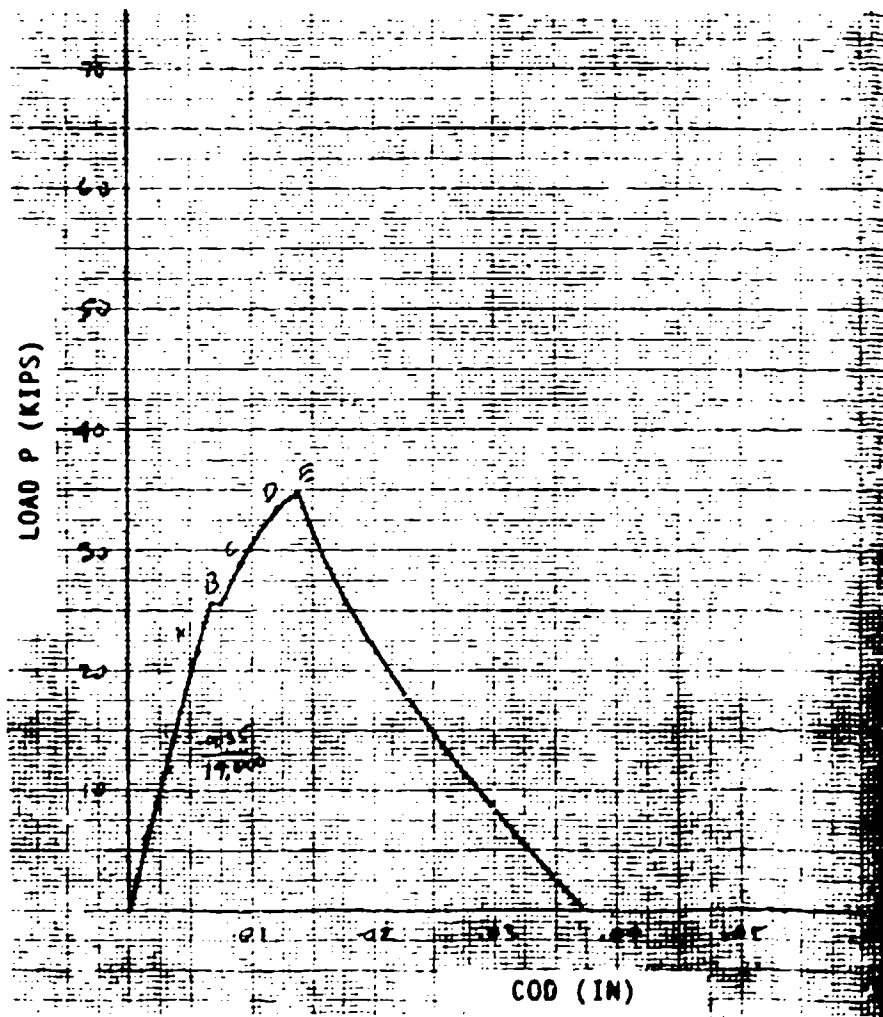
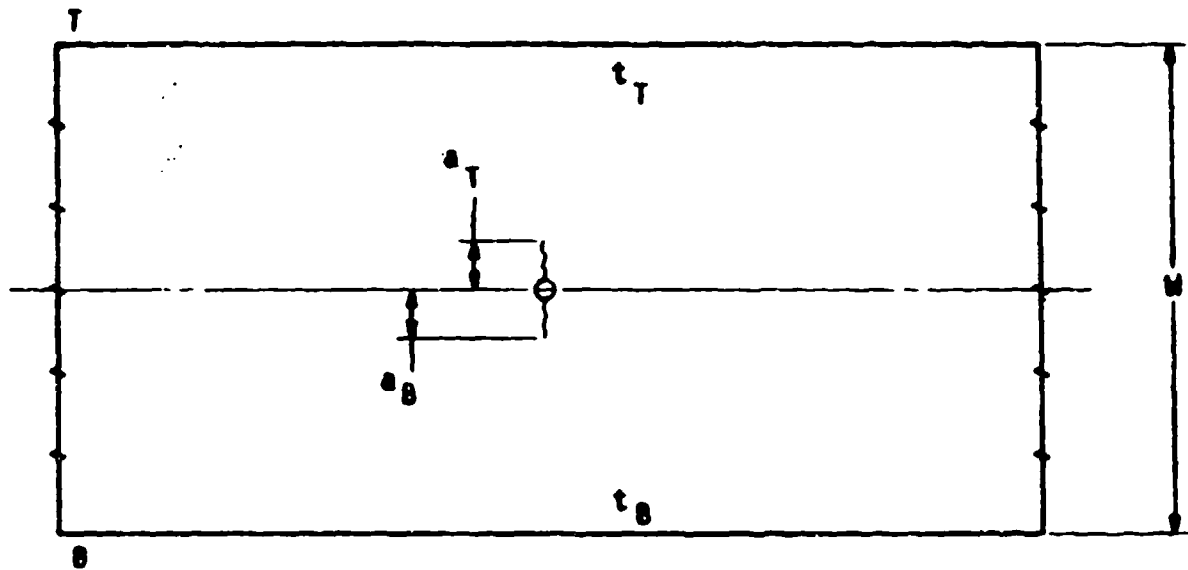


Figure 4-158. Applied Load vs. Crack Opening Displacement GT160KAB51-11A

SPECIMEN NO. GT160KAB51-11B

MAT'L — 7075-T651



SPECIMEN MEASUREMENTS

$W = 2.999 \text{ in.}$
 $t_T = 0.322 \text{ in.}$
 $t_B = 0.324 \text{ in.}$

$a_T = 0.450 \text{ in.}$
 $a_B = 0.430 \text{ in.}$
 $a_0 = 0.5225 \text{ in.}$

PRECRACK DATA

NET AREA = 0.6844 in.^2

$P_{\max} = 9,445 \text{ lbs}$
 $P_{\min} = 945 \text{ lbs}$

LEFT = $0.068/0.050 \text{ in.}$
RIGHT = $0.080/0.050 \text{ in.}$
No of cycles = 12500

FAILURE LOAD AFTER
PRE-CRACKING
 $P = 31,800 \text{ lbs}$

Figure 4-16A. Fracture Toughness Data Sheet GT160KAB51-11B

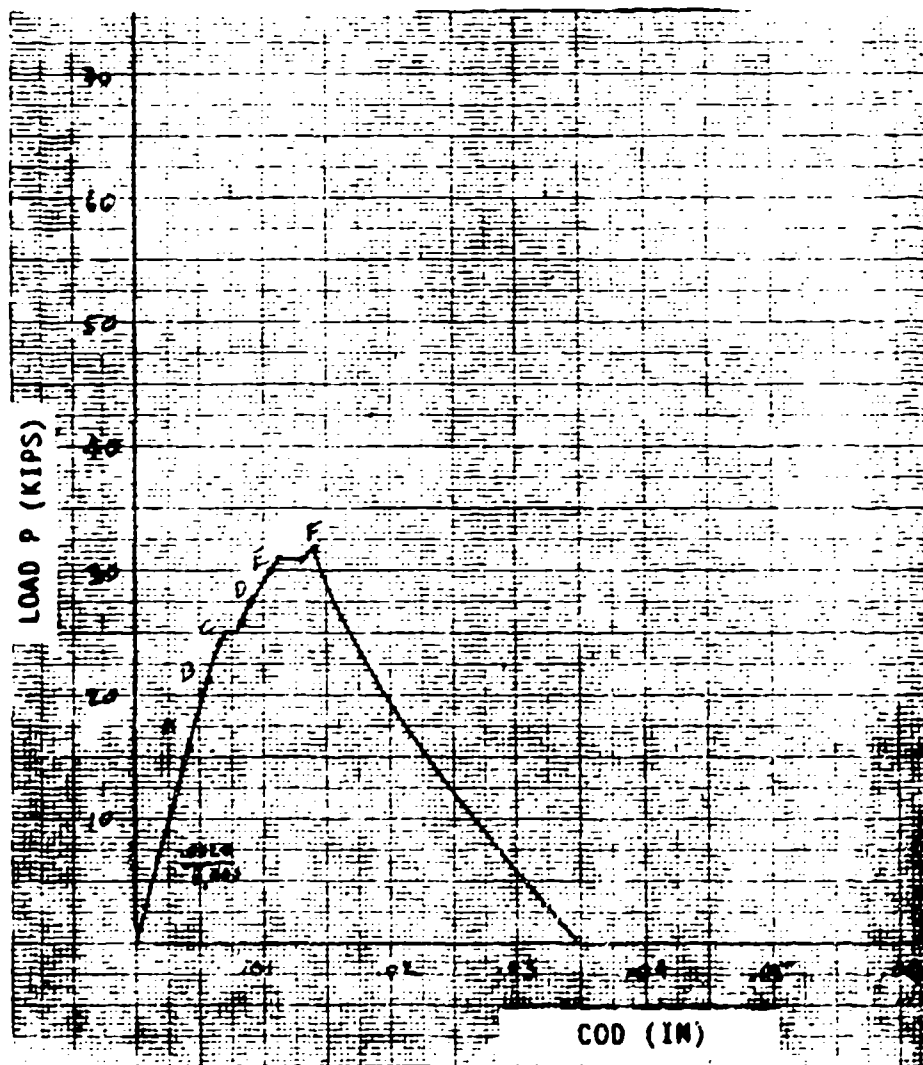
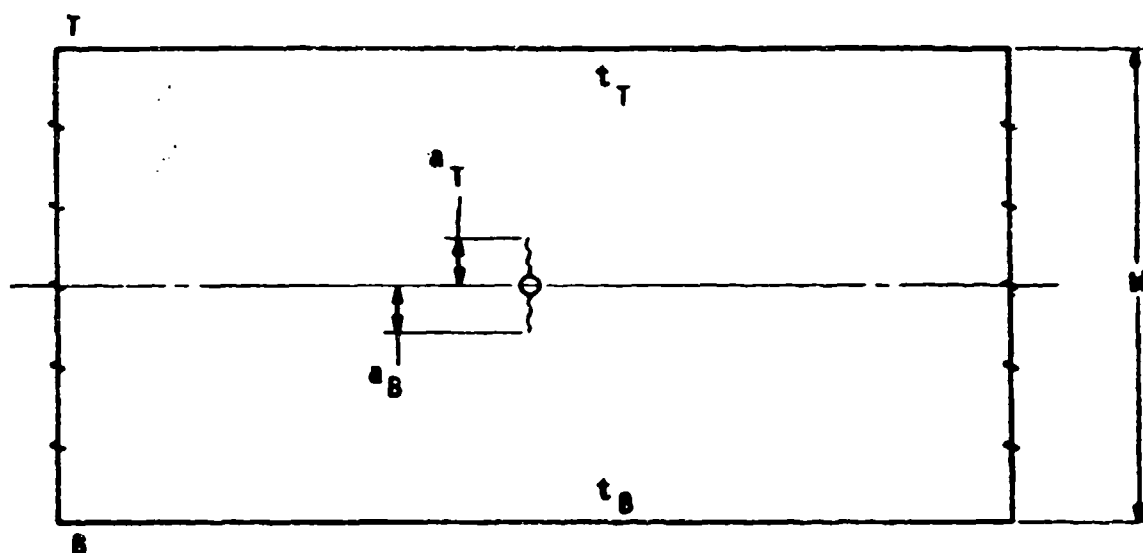


Figure 4-16B. Applied Load vs. Crack Opening Displacement GT160KAB51-11B

SPECIMEN NO. GT160KAB51-13B

MAT'L — 7075-T651



SPECIMEN MEASUREMENTS

W = 3.005 in.
t_T = 0.406 in.
t_B = 0.406 in.

a_T = 0.450 in.
a_B = 0.460 in.
a₀ = 0.535 in.

PRECRACK DATA

NET AREA = 0.8506 in.²

P_{max} = 11,738 lbs
P_{min} = 1,174 lbs

LEFT = 0.080/0.076 in.
RIGHT = 0.068/0.055 in.
No of cycles = 9450

FAILURE LOAD AFTER
PRE-CRACKING
P = 34,500 lbs

Figure 4-17A. Fracture Toughness Data Sheet GT160KAB51-13B

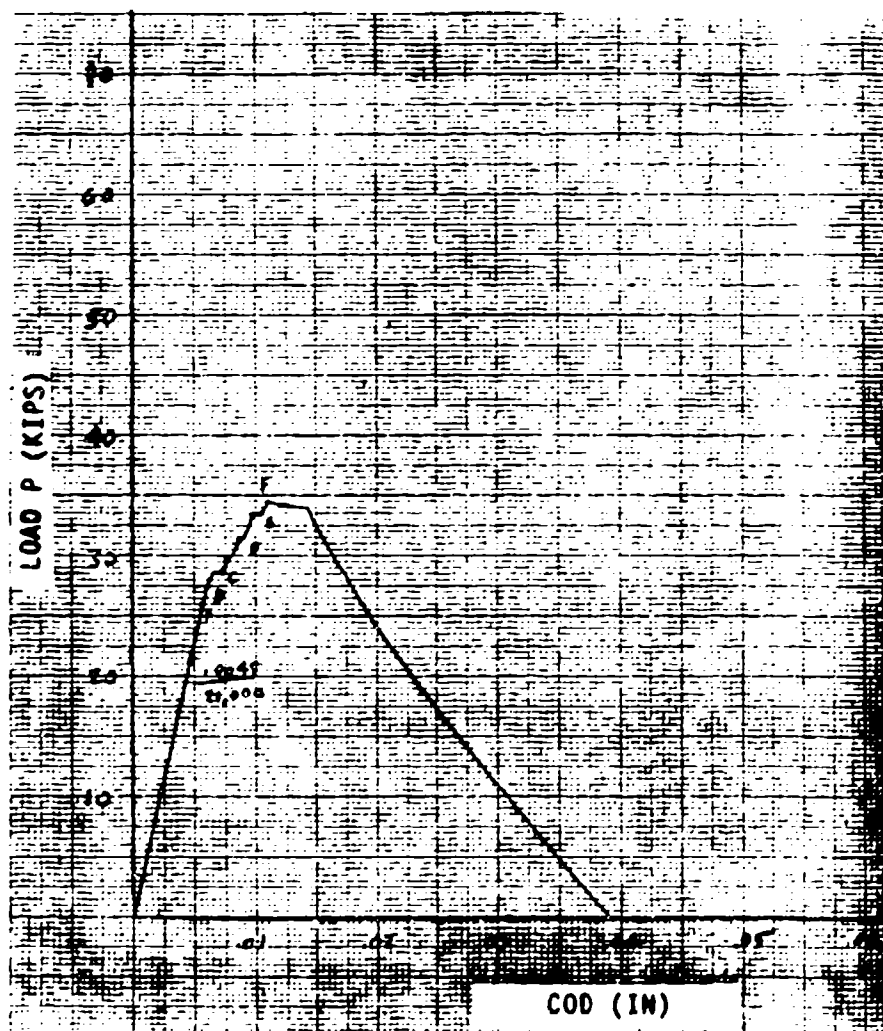
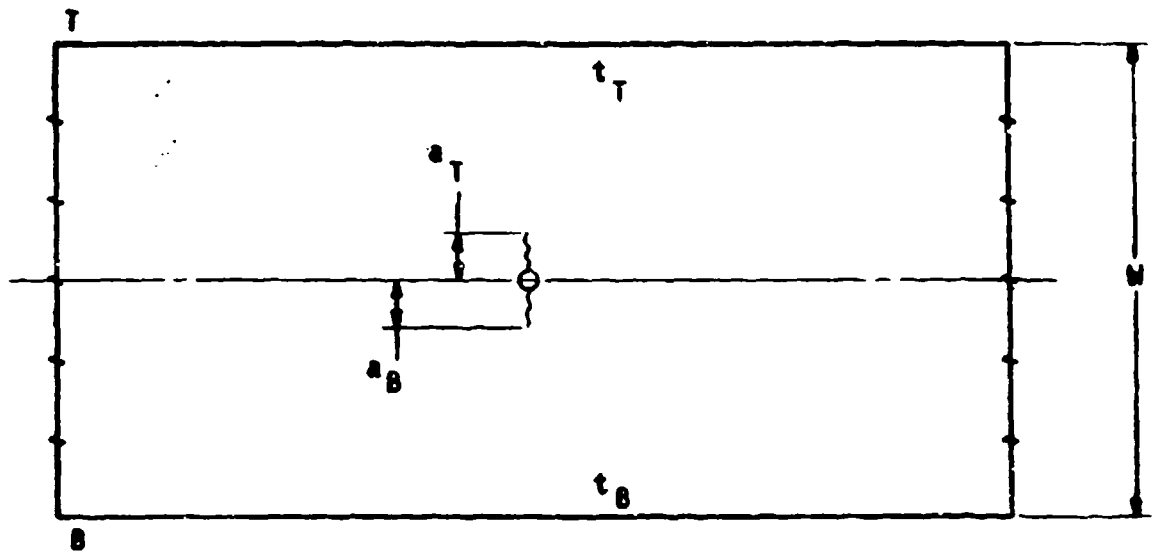


Figure 4-178. Applied Load vs. Crack Opening Displacement GT160KA851-13B

SPECIMEN NO. GT160KAB51-13C

MAT'L — 7075-T651



SPECIMEN MEASUREMENTS

W = 2.999 in.
t_T = 0.4060 in.
t_B = 0.4055 in.

a_T = 0.440 in.
a_B = 0.460 in.
a₀ = 0.525 in.

PRECRACK DATA

NET AREA = 0.8517 in.²

P_{max} = 11,753 lbs
P_{min} = 1,175 lbs

LEFT = 0.062/0.050 in.
RIGHT = 0.068/0.050 in.
No of cycles = 10332

FAILURE LOAD AFTER
PRE-CRACKING
P = 37,000 lbs

Figure 4-18A. Fracture Toughness Data Sheet GT160KAB51-13C

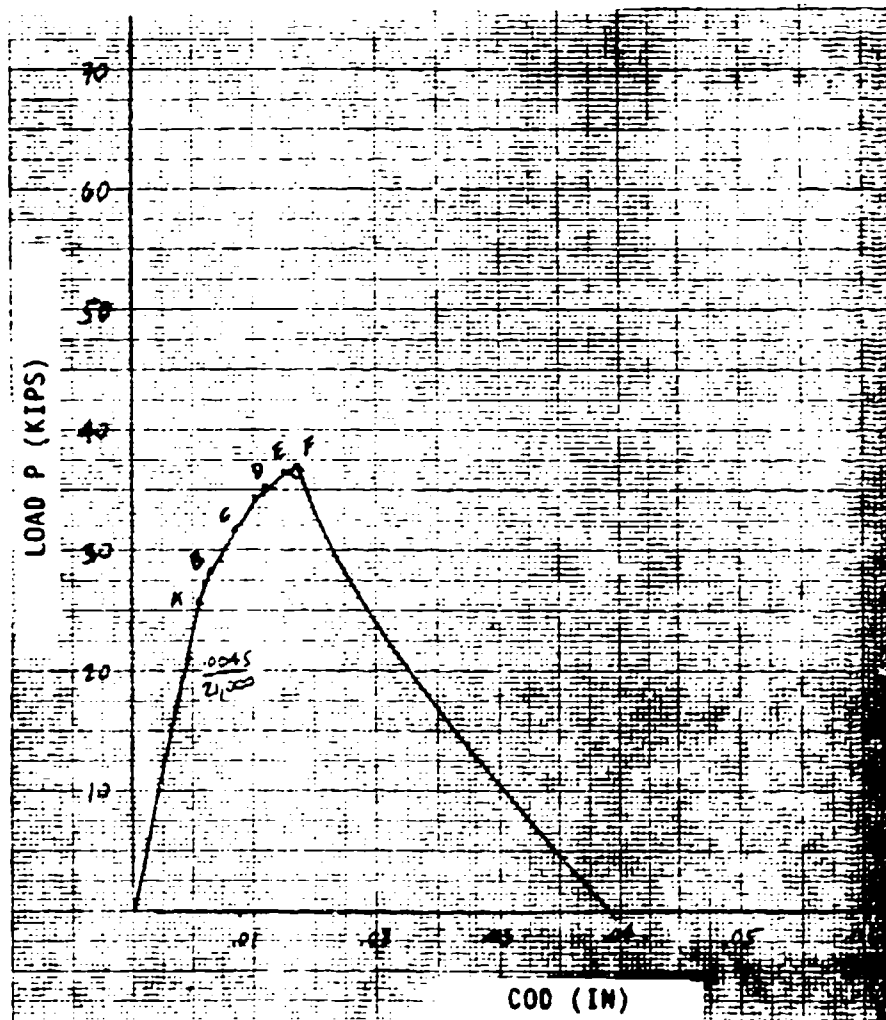
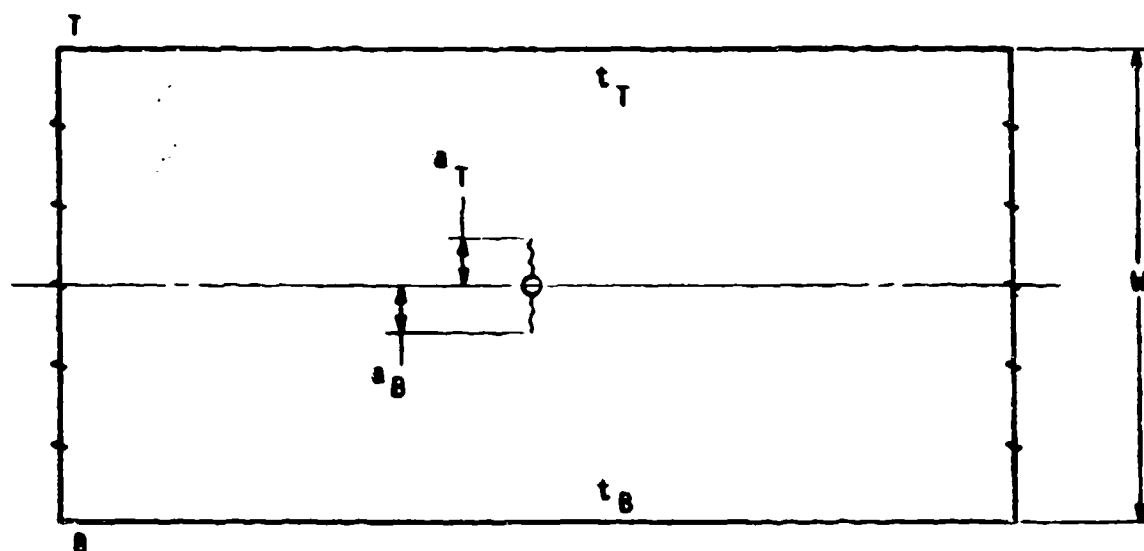


Figure 4-18B. Applied Load vs. Crack Opening Displacement GT160KAB51-13C

SPECIMEN NO. GT160KAB51-15B

MAT'L — 7075-T6



SPECIMEN MEASUREMENTS

$W = 12.00 \text{ in.}$

$t_T = 0.1573 \text{ in.}$

$t_B = 0.1570 \text{ in.}$

$a_T = 1.785 \text{ in.}$

$a_B = 1.785 \text{ in.}$

$a_0 = 1.870 \text{ in.}$

PRECRACK DATA

NET AREA = 1.3248 in.^2

$P_{\max} = 18,800 \text{ lbs}$

$P_{\min} = 1,880 \text{ lbs}$

LEFT = $0.060/0.050 \text{ in.}$

RIGHT = $0.065/0.060 \text{ in.}$

No of cycles = 1173

FAILURE LOAD AFTER
PRE-CRACKING

$P = 59,750 \text{ lbs}$

Figure 4-19A. Fracture Toughness Data Sheet GT160KAB51-15B

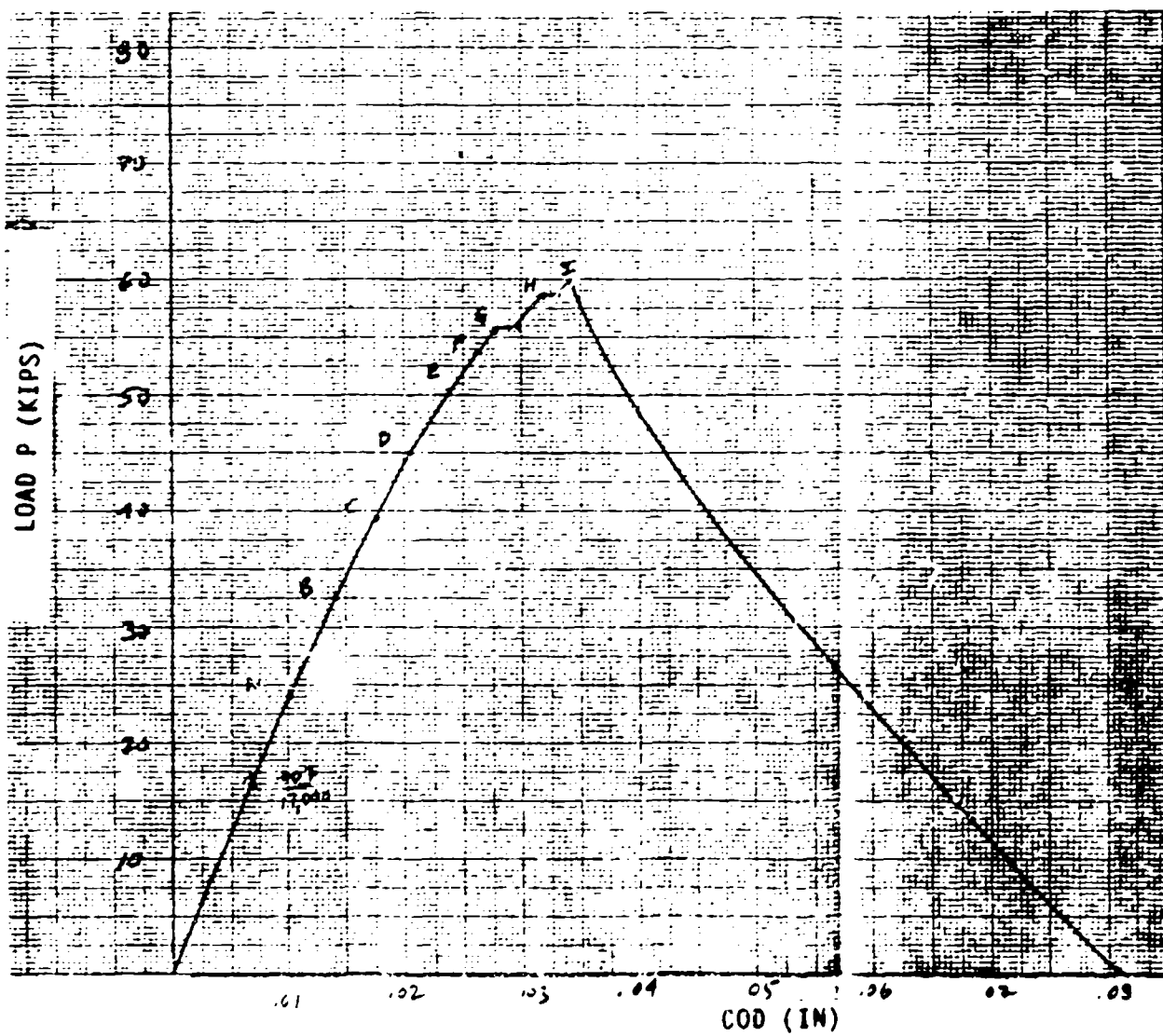
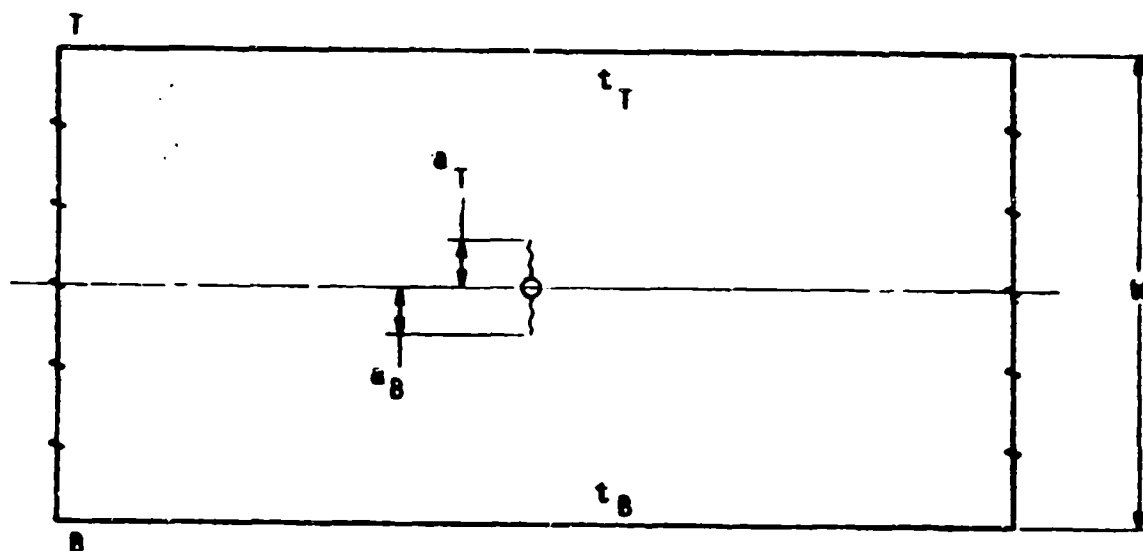


Figure 4-19B. Applied Load vs. Crack Opening Displacement GT160KAB51-15B

SPECIMEN NO. GT160KAB51-15C

MAT'L — 7075-T6



SPECIMEN MEASUREMENTS

$W = 12.00 \text{ in.}$
 $t_T = 0.1558 \text{ in.}$
 $t_B = 0.1569 \text{ in.}$

$a_T = 1.810 \text{ in.}$
 $a_B = 1.810 \text{ in.}$
 $a_0 = 1.895 \text{ in.}$

PRECRACK DATA

NET AREA = 1.3102 in.^2

$P_{\max} = 18,600 \text{ lbs}$
 $P_{\min} = 1,860 \text{ lbs}$

LEFT = $0.080/0.070 \text{ in.}$
 RIGHT = $0.050/.100 \text{ in.}$
 No of cycles = 1477

FAILURE LOAD AFTER
 PRE-CRACKING
 $P = 59,500 \text{ lbs}$

Figure 4-20A. Fracture Toughness Data Sheet GT160KAB51-15C

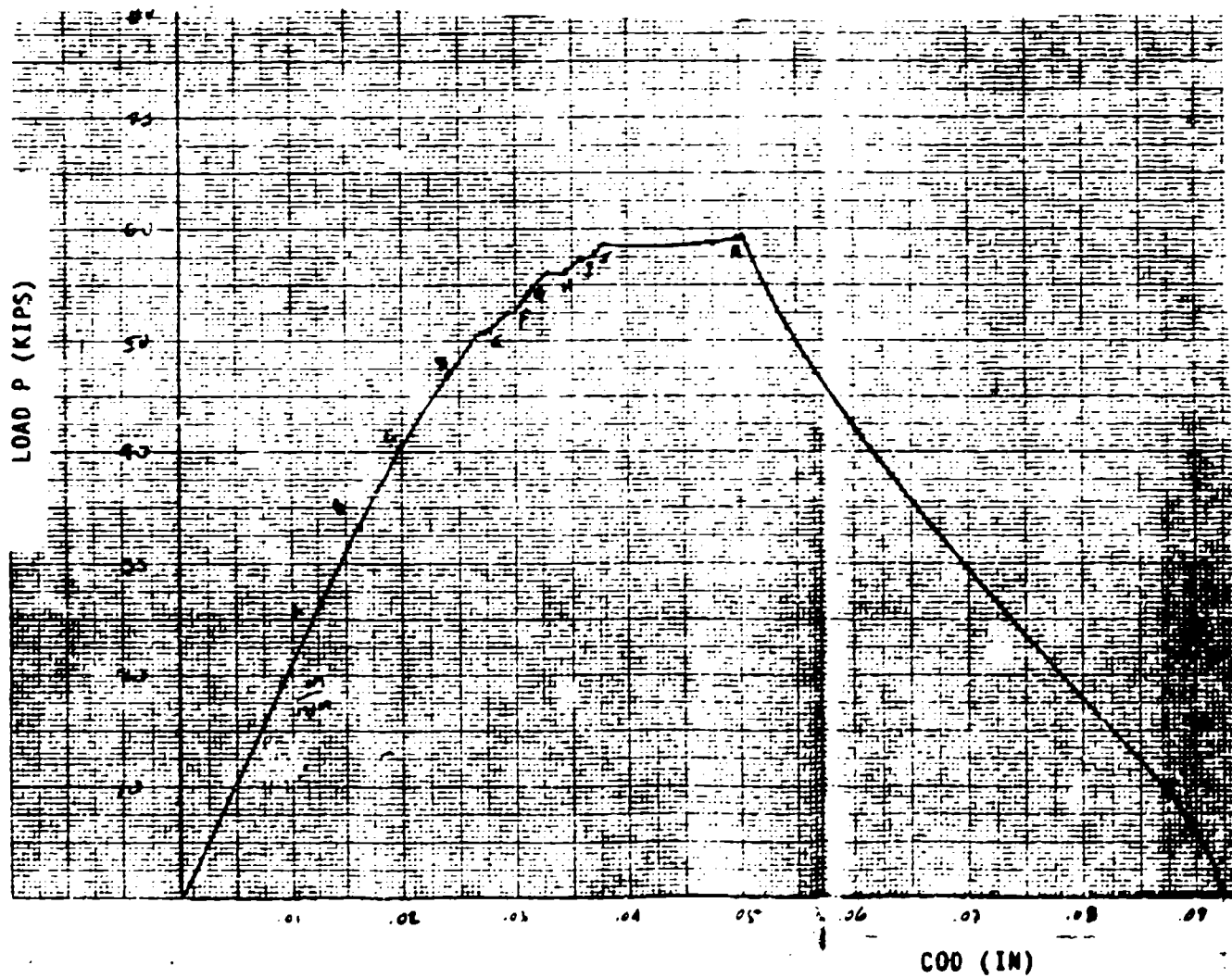
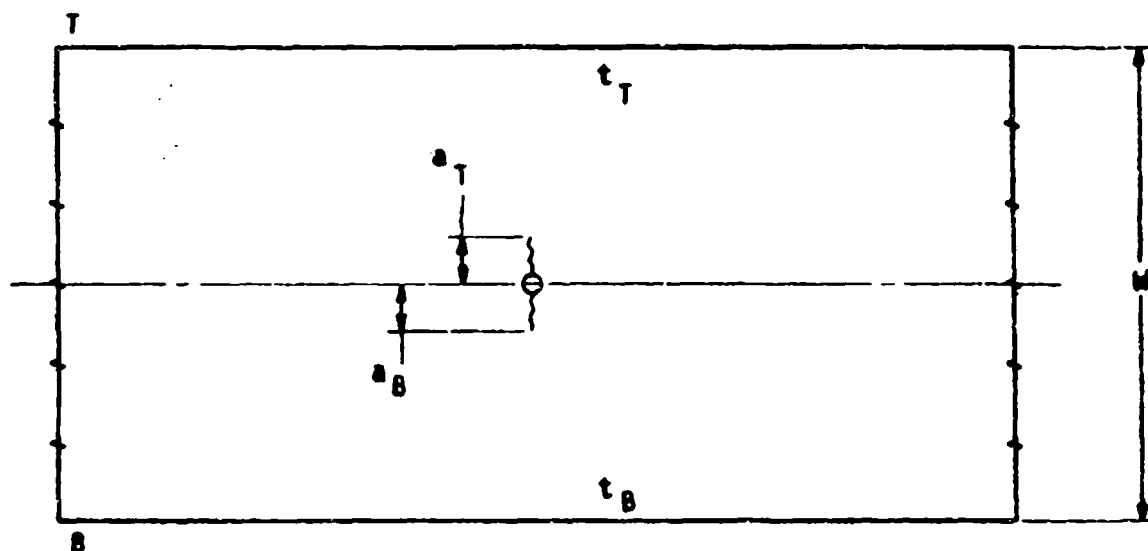


Figure 4-208. Applied Load vs. Crack Opening Displacement GT160KAB51-15C

SPECIMEN NO. GT160KAB51-17B

MAT'L — 7075-T6511 EXT.



SPECIMEN MEASUREMENTS

W = 2.748 in.

t_T = 0.300 in.

t_B = 0.3015 in.

a_T = 0.430 in.

a_B = 0.430 in.

a_0 = 0.485 in.

PRECRACK DATA

NET AREA = 0.5678 in.²

P_{max} = 8,290 lbs

P_{min} = 829 lbs

LEFT = 0.045/0.050 in.

RIGHT = 0.040/0.060 in.

No of cycles = 17500

FAILURE LOAD AFTER

PRE-CRACKING

P = 34,900 lbs

Figure 4-21A. Fracture Toughness Data Sheet GT160KAB51-17B

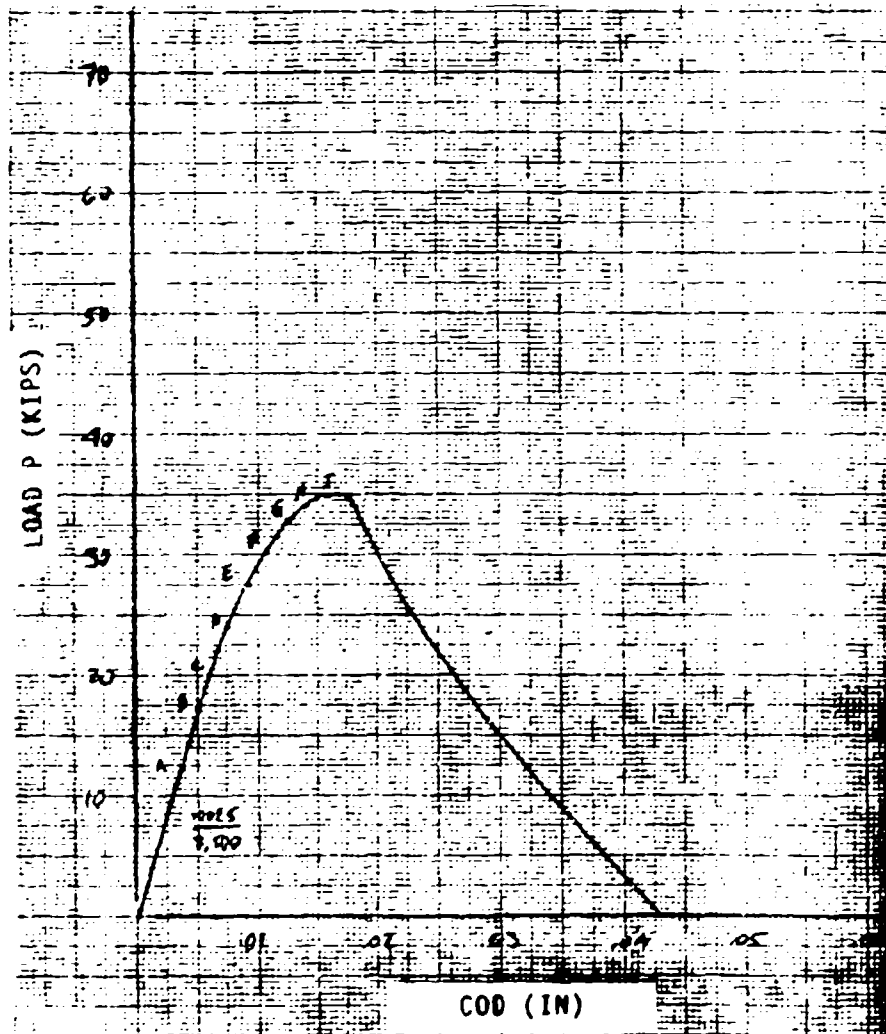
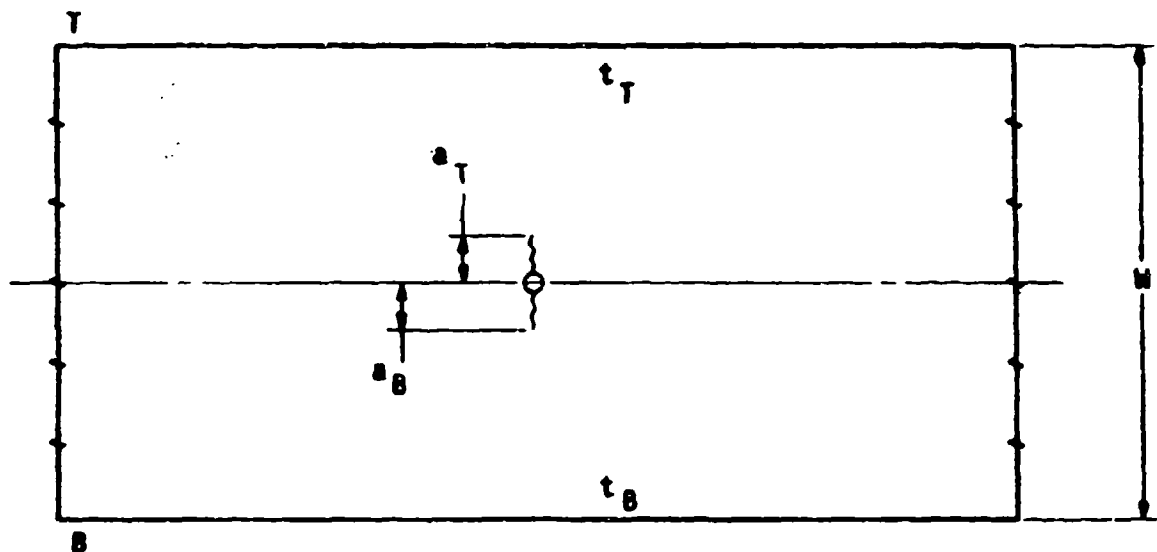


Figure 4-21B. Applied Load vs. Crack Opening Displacement GT160KAB51-17B

SPECIMEN NO. GT160KAB51-17C

MAT'L — 7075-T6511 EXT.



SPECIMEN MEASUREMENTS

W = 2.7475 in.
t_T = 0.2975 in.
t_B = 0.2985 in.

a_T = 0.400 in.
a_B = 0.410 in.
a_o = 0.510 in.

PRECRACK DATA

NET AREA = 0.5774 in.²

P_{max} = 8,430 lbs
P_{min} = 843 lbs

LEFT = 0.055/0.065 in.
RIGHT = 0.082/0.070 in.
No of cycles = 8860

FAILURE LOAD AFTER
PRE-CRACKING
P = 32,500 lbs

Figure 4-22A. Fracture Toughness Data Sheet GT160KAB51-17C

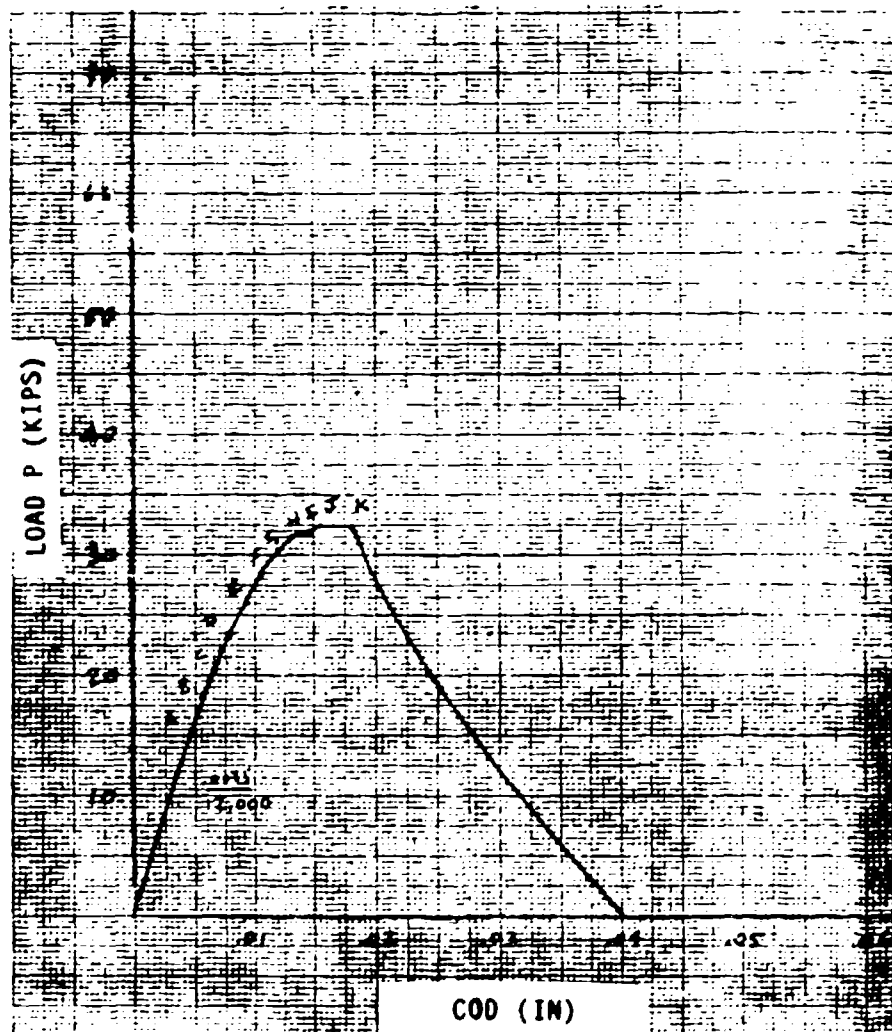
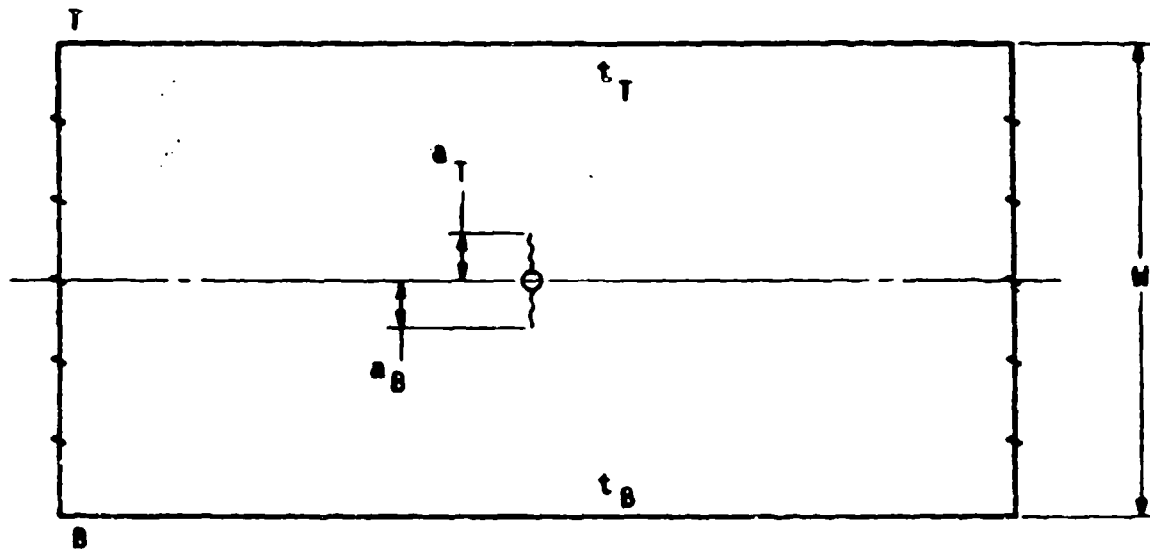


Figure 4-22B. Applied Load vs. Crack Opening Displacement GT160KAB51-17C

SPECIMEN NO. GT160KAB51-19A

MAT'L — 7075-T6511 EXT.



SPECIMEN MEASUREMENTS

W = 2.746 in.
t_T = 0.314 in.
t_B = 0.307 in.

a_T = 0.400 in.
a_B = 0.410 in.
a₀ = 0.475 in.

PRECRACK DATA

NET AREA = 0.6011 in.²

P_{max} = 8,776 lbs
P_{min} = 876 lbs

LEFT = 0.060/0.050 in.
RIGHT = 0.062/0.067 in.
No of cycles = 14235

FAILURE LOAD AFTER
PRE-CRACKING
P = 32,500 lbs

Figure 4-23A. Fracture Toughness Data Sheet GT160KAB51-19A

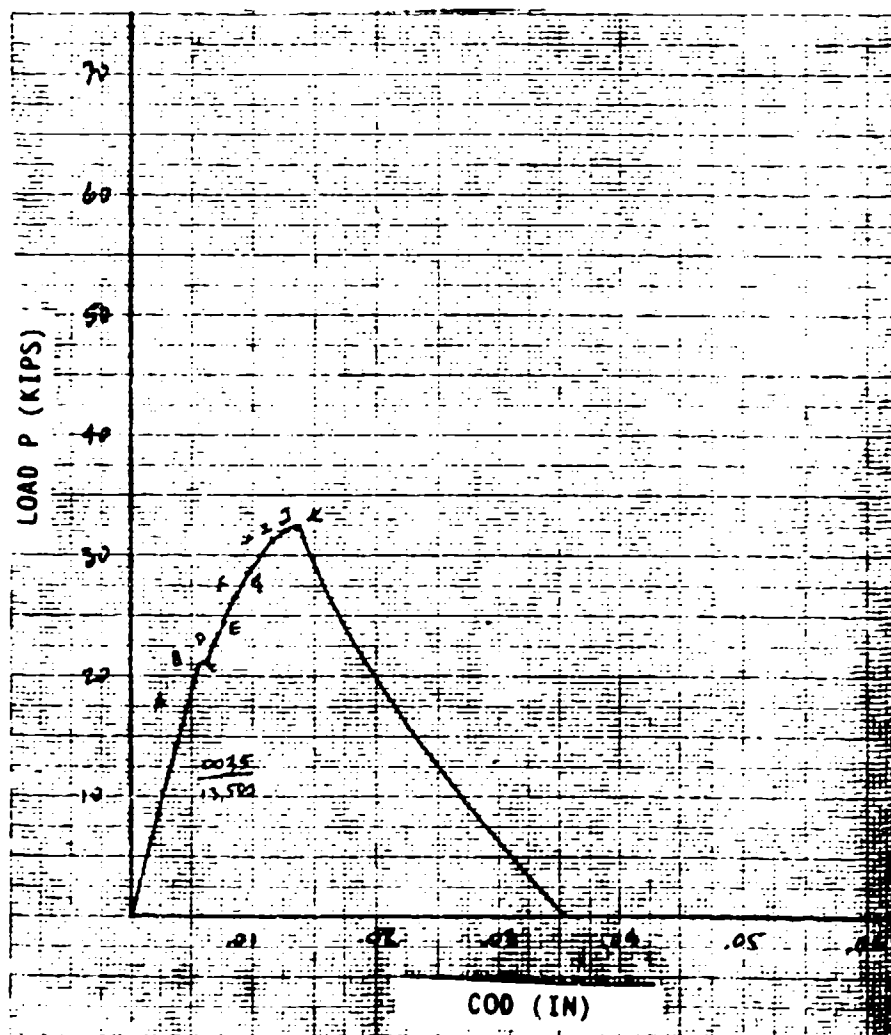
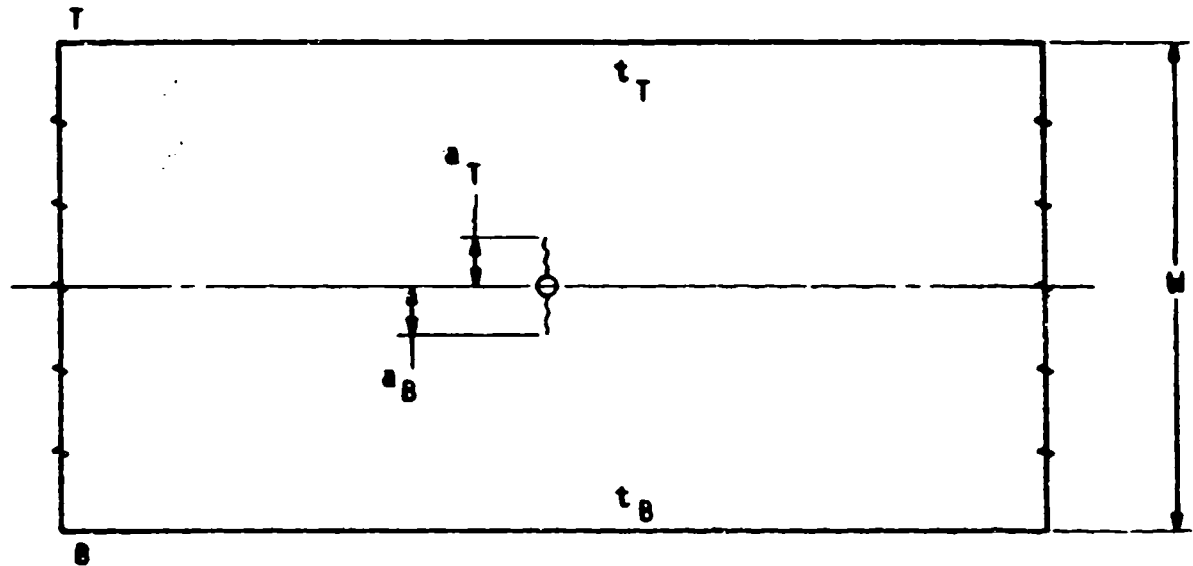


Figure 4-23B. Applied Load vs. Crack Opening Displacement GT160KAB51-19A

SPECIMEN NO. GT160KAB51-198

MAT'L — 7075-T6511 EXT.



SPECIMEN MEASUREMENTS

$W = 2.747$ in.
 $t_T = 0.3105$ in.
 $t_B = 0.3095$ in.

$a_T = 0.400$ in.
 $a_B = 0.410$ in.
 $a_0 = 0.5225$ in.

PRECRACK DATA

NET AREA = 0.6005 in.²

$P_{max} = 8,767$ lbs
 $P_{min} = 877$ lbs

LEFT = $0.095/0.050$ in.
RIGHT = $0.090/0.090$ in.
Nc of cycles = 9296

FAILURE LOAD AFTER
PRE-CRACKING
 $P = 32,250$ lbs

Figure 4-24A. Fracture Toughness Data Sheet GT160KAB51-198

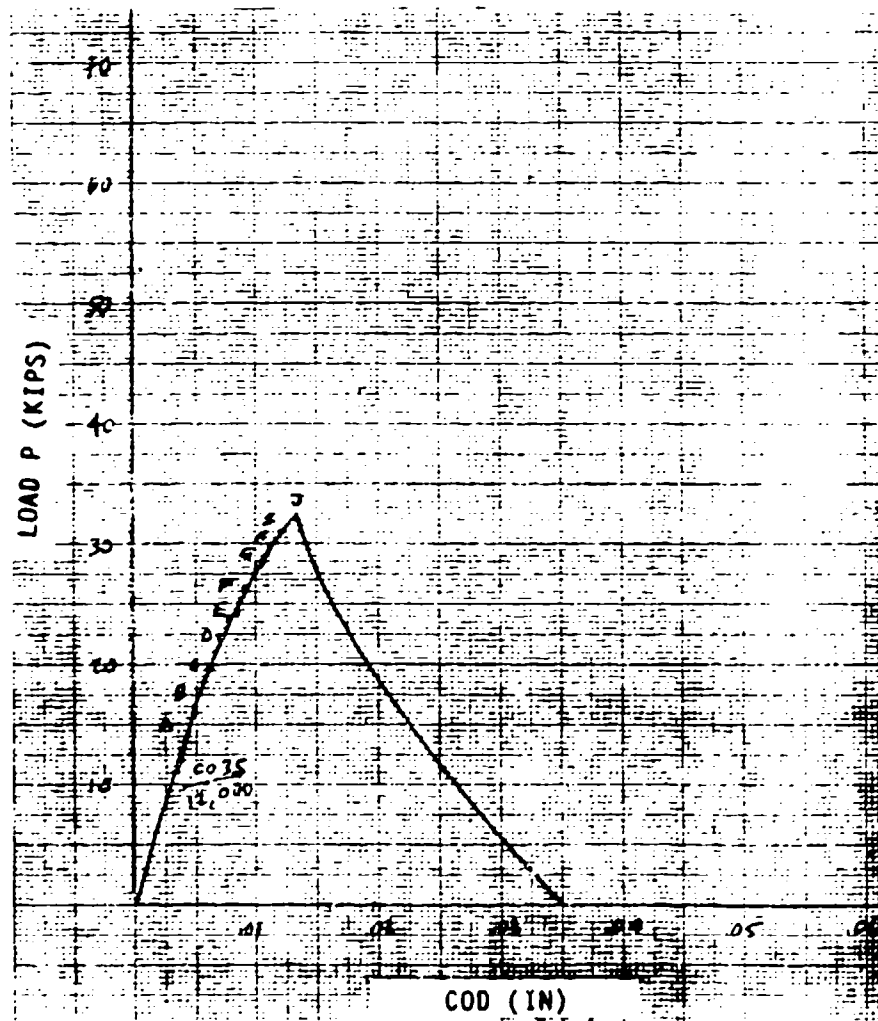


Figure 4-24B. Applied Load vs. Crack Opening Displacement GT160KAB51-198

5.0 CONSTANT AMPLITUDE CRACK GROWTH RATES TEST PROGRAM

The purpose of the constant amplitude crack growth rate test program was to establish crack growth allowables for the material form used during the structural test program. The specimens were manufactured and tested in compliance with ASTM standard E-647. The test data were fit into the "Modified Walker Equation" in term of da/dn vs K_{max} .

5.1 TEST SPECIMENS

A total of sixty-four (64) specimen were tested. The specimen configurations are shown in Figures 5-1 through 5-3. The specimens were made of 2024-T3XX and 7075-T6XX aluminum alloys, and included sheet, plate and extruded sections. The selection of the material type and material form was consistent with that used during the structural test program. Each specimen contained an initial flaw at mid section. The flaw was introduced by means of a saw-cut followed by the application of constant amplitude cycles. During the test, measurements of the crack growth were made using 'KRAK GAGES' installed on both sides of the crack. The specimens were manufactured at FRC, and tested at Mechanical Technology, Inc. located in Latham, N.Y.

5.2 TEST ENVIRONMENT

The specimens were tested under a controlled lab-air environment. The test frequency was approximately 10 Hz.

5.3 LOADING SPECTRUM

The specimens were subjected to constant amplitude loading, with maximum stress levels and stress ratios from 7.0 Ksi to 12.5 Ksi, and -0.50 to 0.50 respectively (Ref. Table 5-1).

5.4 TEST RESULTS

The test results of sixty-four (64) constant amplitude test specimens are summarized in Table 5-1. The crack propagation data for each specimen is provided in Tables 5-2 through 5-65. Most of the data shows consistent results with a relatively small degree of scatter. The test data were separated into groups of similar material form and stress ratios. Subsequently, the

Walker Constants were evaluated using a best fit curve. For the majority of the specimens, an excellent fit was obtained. An exception was the testing of the 2024-T3511 Tee section at $R > 0.0$, and the 7075-T611 Tee section at $R > 0.0$. The Raw Test Data for the 2024-T3511 Tee Section, S/N No. 2, and 7075-T6511 Tee Section, S/N No. 3 were therefore not used.

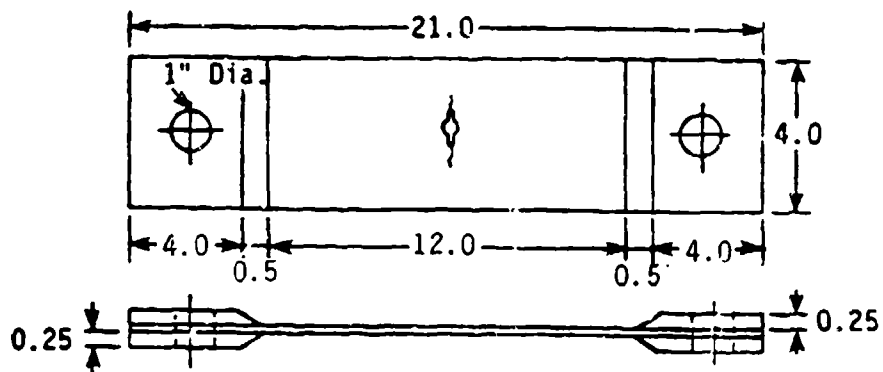


Figure 5-1. Crack Growth Specimen - 4" Wide

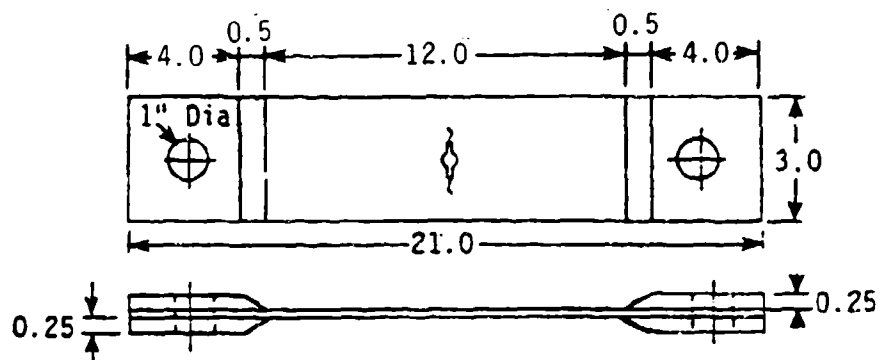


Figure 5-2. Crack Growth Specimen - 3" Wide

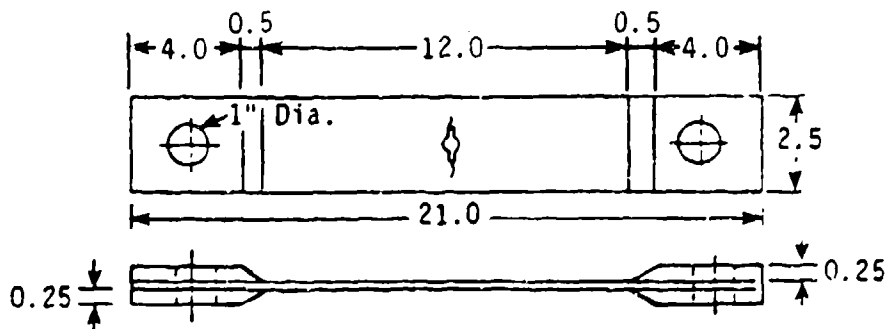


Figure 5-3. Crack Growth Specimen - 2.5" Wide

TABLE 5-1. SUMMARY OF CONSTANT AMPLITUDE COUPON TEST

REF. GT160KAB49- DASH	S/N	PRODUCT FORM	W (IN)	t (IN)	σ_{max} (ksi)	R	CYCLES TO FAILURE	a_{cr} (IN)
-1	1	2024-T3 Sheet	4.01	0.195	7.30	0.05	195,793	1.3987
↑	2	↑	4.01	0.195	12.34	0.05	31,761	1.3599
↓	3	↓	4.01	0.195	8.26	0.50	560,027	1.3541
-1	4	2024-T3 Sheet	4.01	0.195	12.37	0.50	103,620	0.9772
-21	1	2024-T3 Sheet	4.00	0.195	7.23	-0.31	169,654	1.4133
↑	2	↑	4.00	0.195	11.95	-0.30	30,356	1.3431
↓	3	↓	4.00	0.195	7.25	-0.50	165,200	1.3781
-21	4	2024-T3 Sheet	4.00	0.195	11.78	-0.50	31,286	1.4157
-03	1	2024-T351 Plate	4.00	0.250	7.62	0.05	183,160	1.3537
↑	2	↑	4.00	0.250	11.95	0.05	38,344	1.6596
↓	3	↓	4.00	0.250	7.60	0.50	1,039,616	1.3450
-03	4	2024-T351 Plate	4.00	0.250	11.96	0.50	132,349	1.3789
-23	1	2024-T351 Plate	4.01	0.250	7.00	-0.30	161,030	1.4048
↑	2	↑	4.01	0.250	11.97	-0.30	31,604	1.4439
↓	3	↓	4.01	0.250	7.06	-0.50	131,996	1.4088
-23	4	2024-T351 Plate	4.01	0.250	12.08	-0.50	40,827	1.3700
-07	1	2024-T3511 Angle	2.25	0.250	8.10	0.05	264,603	0.8205
↑	2	↑	2.25	0.250	10.54	0.05	73,321	0.8530
↓	3	↓	2.26	0.250	8.97	0.50	552,960	0.7421
-07	4	2024-T3511 Angle	2.26	0.250	12.40	0.50	149,082	0.4424
-27	1	2024-T3511 Angle	2.25	0.250	8.90	-0.30	361,811	0.7861
↑	2	↑	2.25	0.250	12.05	-0.30	52,950	0.8689
↓	3	↓	2.25	0.250	8.85	-0.50	365,959	0.8297
-27	4	2024-T3511 Angle	2.25	0.250	12.15	-0.50	58,846	0.9225
-05	1	2024-T3511 Tee	2.75	0.200	6.74	0.05	176,105	0.8633
↑	2	↑	2.75	0.192	11.42	0.05	215,109	0.9029
↓	3	↓	2.75	0.193	7.69	0.50	404,202	0.8580
-05	4	2024-T3511 Tee	2.75	0.198	11.15	0.50	257,406	0.8638
-25	1	2024-T3511 Tee	2.74	0.186	7.74	-0.30	215,060	0.9162
↑	2	↑	2.74	0.188	12.15	-0.30	19,050	0.9176
↓	3	↓	2.74	0.187	6.61	-0.50	105,610	0.9488
-25	4	2024-T3511 Tee	2.74	0.187	11.10	-0.50	20,451	0.8583
-11	1	7075-T6 Sheet	4.00	0.156	6.85	0.05	64,645	1.4916
↑	2	↑	4.00	0.156	11.90	0.05	17,792	0.9645
↓	3	↓	4.00	0.156	7.88	0.50	197,716	1.7698
-11	4	7075-T6 Sheet	4.00	0.156	12.05	0.50	36,996	1.5173

TABLE 5-1. SUMMARY OF CONSTANT AMPLITUDE COUPON TEST (Continued)

REF. GT160KAB49- DASH	S/N	PRODUCT FORM	W (IN)	t (IN)	σ_{max} (ksi)	R	CYCLES TO FAILURE	a_{cr} (IN)
-31	1	7075-T6 Sheet	4.00	0.158	6.85	-0.31	56,745	1.3239
↑	2	↑	4.00	0.158	11.98	-0.31	21,924	1.4690
↓	3	↓	4.00	0.158	7.00	-0.50	70,093	1.3450
-31	4	7075-T6 Sheet	4.00	0.158	12.00	-0.50	23,348	1.2650
-13	1	7075-T651 Plate	3.00	0.322	4.65	0.05	342,911	1.0775
↑	2	↑	3.00	0.322	10.50	0.05	39,107	1.2113
↓	3	↓	3.00	0.321	3.15	0.50	385,065	1.2180
-13	4	7075-T651 Plate	3.00	0.321	6.02	0.50	70,333	1.1775
-33	1	7075-T651 Plate	3.00	0.320	7.05	-0.30	71,502	1.0691
↑	2	↑	3.00	0.320	10.53	-0.30	37,051	0.9264
↓	3	↓	3.00	0.320	7.07	-0.50	80,404	0.8983
-33	4	7075-T651 Plate	3.00	0.320	11.38	-0.50	26,917	1.1493
-17	1	7075-T6511 Angle	2.75	0.309	7.12	0.05	129,789	0.6764
↑	2	↑	2.75	0.308	11.32	0.05	36,556	1.0085
↓	3	↓	2.75	0.307	7.24	0.50	272,880	1.1025
-17	4	7075-T6511 Angle	2.75	0.310	11.20	0.50	56,064	0.9471
-37	1	7075-T6511 Angle	2.75	0.320	7.00	-0.33	52,737	0.9171
↑	2	↑	2.75	0.320	11.89	-0.31	14,097	1.2785*
↓	3	↓	2.75	0.320	6.98	-0.51	66,755	0.9118
-37	4	7075-T6511 Angle	2.75	0.320	11.43	-0.50	12,323	1.1567
-15	1	7075-T6511 Tee	2.75	0.300	6.85	0.05	38,364	0.9522
↑	2	↑	2.75	0.300	10.73	0.05	29,848	1.1217
↓	3	↓	2.75	0.300	6.85	0.50	631,411	1.0358
-15	4	7075-T6511 Tee	2.75	0.300	11.04	0.50	66,364	0.9450
-35	1	7075-T6511 Tee	2.75	0.302	6.82	-0.33	53,127	1.1860
↑	2	↑	2.74	0.312	11.19	-0.30	19,224	1.1809*
↓	3	↓	2.74	0.312	6.80	-0.50	39,772	1.0807
-35	4	7075-T6411 Tee	2.75	0.302	11.86	-0.50	23,327	1.032

*Net stress exceed yield stress at failure

TABLE 5-2. CRACK GROWTH DATA SPECIMEN GT160KAB49-01 S/N 1

CYCLE #	CRACK LENGTH (INS)			MAX STRESS (PSI)	STRESS RATIO	15-531	1--239	1.2402	1.3531	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267
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TABLE 5-4. CRACK GROWTH DATA SPECIMEN GT160KAB49-01 S/N 3

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT AVERAGE		
1.	0.3490	0.3400	0.3445	0.213
62512.	0.3423	0.3461	0.3452	0.499
98266.	0.3897	0.3750	0.3813	0.500
149937.	0.4071	0.3987	0.4029	0.498
202329.	0.4234	0.4207	0.4220	0.498
242860.	0.4478	0.4333	0.4416	0.498
269172.	0.4624	0.4619	0.4621	0.496
297060.	0.4868	0.4726	0.4797	0.498
319404.	0.5048	0.4989	0.5018	0.495
341655.	0.5292	0.5111	0.5202	0.497
358812.	0.5478	0.5337	0.5408	0.498
374690.	0.5664	0.5537	0.5611	0.497
389502.	0.5844	0.5783	0.5814	0.497
399660.	0.6089	0.5869	0.5979	0.498
411496.	0.6292	0.6126	0.6209	0.497
42440.	0.6336	0.6286	0.6401	0.498
43314.	0.6705	0.6450	0.6577	0.497
443309.	0.6923	0.6645	0.6800	0.498
451547.	0.7187	0.6841	0.7014	0.497
461906.	0.7362	0.5804	0.6583	0.498
489629.	0.7371	0.7317	0.7344	0.497
487942.	0.7827	0.7501	0.7664	0.498
483450.	0.8059	0.7715	0.7887	0.497
484389.	0.8274	0.7910	0.8092	0.497
493780.	0.8478	0.8118	0.8298	0.497
498366.	0.8687	0.8361	0.8494	0.498
502355.	0.8885	0.8485	0.8685	0.498
50744.	0.9094	0.8737	0.8906	0.497
513730.	0.9344	0.8925	0.9134	0.497
516095.	0.9588	0.9059	0.9324	0.498
518962.	0.9722	0.9194	0.9513	0.498
522387.	0.9960	0.9450	0.9705	0.497
525743.	1.0210	0.9572	0.9891	0.498
529417.	1.0437	0.9762	1.0099	0.497
531565.	1.0617	1.0006	1.0312	0.498
534488.	1.0822	1.0139	1.0533	0.498
536607.	1.1047	1.0373	1.0703	0.498
538412.	1.1257	1.0550	1.0903	0.498
540675.	1.1454	1.0711	1.1088	0.498
542729.	1.1664	1.0917	1.1190	0.497
545071.	1.1914	1.1113	1.1513	0.495
546968.	1.2135	1.1284	1.1709	0.498
549167.	1.2379	1.1479	1.1928	0.498
551137.	1.2605	1.1687	1.2146	0.498
552461.	1.2850	1.1846	1.2348	0.493
553938.	1.2994	1.2048	1.2571	0.494
555679.	1.3326	1.2261	1.2794	0.498
556792.	1.3553	1.2458	1.2981	0.497
557982.	1.3721	1.2594	1.3160	0.499
559018.	1.3966	1.2720	1.3343	0.498
560027.	1.4204	1.2875	1.3541	0.498

TABLE 5-5. CRACK GROWTH DATA SPECIMEN GT160KAB49-01 S/N 4

CYCLE #	CRACK LENGTH (INS)			MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT	AVERAGE		
7036	0.3172	0.2982	0.3078	12369	0.497
76633	0.3176	0.3199	0.3297	12356	0.498
23669	0.3601	0.3381	0.3491	12369	0.496
29526	0.3789	0.3539	0.3664	12369	0.498
34522	0.4035	0.3709	0.3872	12382	0.496
40079	0.4252	0.3879	0.4065	12369	0.498
43852	0.4437	0.4096	0.4276	12382	0.498
48085	0.4550	0.4201	0.4376	12369	0.497
52874	0.4902	0.4536	0.4719	12382	0.497
56151	0.5149	0.4700	0.4924	12382	0.497
59737	0.5360	0.4899	0.5129	12369	0.497
62357	0.5571	0.5075	0.5323	12382	0.498
65591	0.5805	0.5268	0.5537	12382	0.497
68316	0.5981	0.5491	0.5736	12382	0.497
70256	0.6233	0.5649	0.5941	12369	0.498
72746	0.6450	0.5866	0.6158	12369	0.498
74725	0.6685	0.6071	0.6378	12382	0.498
76743	0.6931	0.6218	0.6574	12356	0.498
78908	0.7124	0.6464	0.6794	12382	0.497
80537	0.7376	0.6529	0.6953	12369	0.497
81936	0.7482	0.6773	0.7128	12369	0.498
82850	0.7716	0.6845	0.7281	12382	0.497
84761	0.7904	0.7092	0.7498	12382	0.497
86312	0.8150	0.7262	0.7706	12395	0.497
87498	0.8349	0.7508	0.7929	12382	0.497
88701	0.8590	0.7602	0.8096	12369	0.498
90083	0.8824	0.7824	0.8324	12369	0.497
91460	0.9035	0.8053	0.8544	12356	0.498
92611	0.8543	0.8299	0.8421	12369	0.497
93708	0.8725	0.8345	0.8635	12369	0.498
94793	0.8947	0.8792	0.8869	12369	0.498
95865	0.9153	0.9028	0.9095	12356	0.498
103620	0.9833	0.9712	0.9772	12369	0.498

TABLE 5-7. CRACK GROWTH DATA SPECIMEN GT160XAB49-21 S/N 2

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO							
	LEFT	RIGHT		AVERAGE							
1542	0.3206	0.3146	0.3177	11926	-302	28634	1.0549	0.9683	1.0119	11913	-303
2548	0.3302	0.3281	0.3292	11899	-303	28987	1.0709	0.9820	1.0264	11886	-303
3508	0.3427	0.3405	0.3416	11913	-301	29120	1.0927	1.0001	1.0464	11940	-302
4419	0.3539	0.3511	0.3535	11913	-303	29354	1.1148	1.0121	1.0635	11899	-301
5215	0.3672	0.3644	0.3658	11926	-303	29390	1.1223	1.0268	1.0856	11972	-303
6038	0.3810	0.3738	0.3774	11926	-303	29533	1.1474	1.0448	1.1061	11886	-301
6879	0.3944	0.3841	0.3894	11913	-302	29691	1.2004	1.0730	1.1365	11913	-301
7822	0.4068	0.3978	0.4023	11886	-303	29854	1.2262	1.0968	1.1615	11913	-303
8804	0.4197	0.4044	0.4120	11913	-303	29958	1.2591	1.1236	1.1923	11872	-303
9839	0.4334	0.4194	0.4252	11913	-303	30057	1.2919	1.1518	1.2218	11913	-301
10922	0.4475	0.4332	0.4399	11913	-305	30158	1.3226	1.1860	1.2543	11913	-302
12088	0.4518	0.4425	0.4492	11940	-303	30257	1.3730	1.2123	1.2927	11953	-302
13353	0.4630	0.4569	0.4609	11886	-303	30356	1.4200	1.2663	1.3431	11926	-303
14739	0.4777	0.4634	0.4706	11899	-302						
16247	0.4913	0.4715	0.4814	11926	-303						
17889	0.5050	0.4830	0.4940	11899	-302						
19679	0.5188	0.4919	0.5053	11940	-303						
21615	0.5321	0.4955	0.5138	11998	-301						
23704	0.5475	0.5085	0.5280	11940	-303						
25952	0.5622	0.5213	0.5393	11926	-303						
28369	0.5777	0.5324	0.5545	11913	-303						
30959	0.5939	0.5483	0.5711	11926	-303						
33739	0.6107	0.5632	0.5870	11926	-303						
36719	0.6282	0.5799	0.6041	11913	-302						
39809	0.6464	0.5978	0.6221	11926	-303						
43019	0.6654	0.6173	0.6414	11940	-303						
46349	0.6859	0.6308	0.6584	11926	-303						
49809	0.7079	0.6498	0.6789	11926	-303						
53399	0.7314	0.6708	0.7011	11926	-303						
57129	0.7564	0.6935	0.7250	11940	-303						
61009	0.7829	0.7188	0.7509	11926	-303						
65049	0.8109	0.7468	0.7789	11886	-303						
69249	0.8404	0.7766	0.8085	11886	-303						
73609	0.8714	0.8088	0.8401	11926	-303						
78129	0.9039	0.8488	0.8764	11913	-303						
82809	0.9379	0.8958	0.9169	11886	-303						
87649	0.9734	0.9355	0.9545	11953	-303						
92659	1.0104	0.9896	1.0000	11926	-303						
97839	1.0489	1.0316	1.0403	11913	-303						
103189	1.0889	1.0698	1.0794	11886	-303						
108709	1.1304	1.1098	1.1201	11886	-303						
114409	1.1734	1.1518	1.1626	11926	-303						
120289	1.2179	1.1958	1.2069	11926	-303						
126349	1.2639	1.2414	1.2527	11926	-303						
132589	1.3114	1.2888	1.2999	11926	-303						
139009	1.3604	1.3374	1.3489	11926	-303						
145609	1.4109	1.3879	1.3994	11926	-303						
152389	1.4629	1.4399	1.4514	11926	-303						
159349	1.5164	1.4949	1.5057	11926	-303						
166489	1.5714	1.5519	1.5617	11926	-303						
173809	1.6279	1.6079	1.6179	11926	-303						
181309	1.6859	1.6654	1.6757	11926	-303						
188989	1.7454	1.7249	1.7352	11926	-303						
196849	1.8064	1.7854	1.7959	11926	-303						
204889	1.8689	1.8479	1.8584	11926	-303						
213009	1.9329	1.9114	1.9222	11926	-303						
221309	1.9984	1.9769	1.9877	11926	-303						
229789	2.0654	2.0439	2.0547	11926	-303						
238449	2.1339	2.1119	2.1229	11926	-303						
247289	2.2039	2.1814	2.1927	11926	-303						
256309											

TABLE 5-8. CRACK GROWTH DATA SPECIMEN GT160KAB49-21 S/N 3

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
33115	0.2940	0.3032	0.2986	122.
33803	0.3061	0.3111	0.3076	7234.
34118	0.3118	0.3239	0.3179	7275
34307	0.3236	0.3359	0.3297	7261.
34903	0.3352	0.3482	0.3417	7302.
35133	0.3442	0.3521	0.3521	7288.
36085	0.3558	0.3688	0.3623	7288.
37238	0.3679	0.3766	0.3722	7275.
38211	0.3802	0.3885	0.3843	7261.
38574	0.3920	0.4015	0.3968	7275.
39356	0.4023	0.4135	0.4079	7288.
40097	0.4097	0.4258	0.4177	7275.
40813	0.4219	0.4352	0.4286	7261.
41331	0.4342	0.4468	0.4405	7248.
42320	0.4467	0.4576	0.4522	7288.
43055	0.4569	0.4701	0.4635	7261.
43880	0.4699	0.4806	0.4748	7274.
44513	0.4812	0.4918	0.4865	7234.
45251	0.4935	0.5047	0.4991	7288.
45980	0.5019	0.5175	0.5099	7275.
46708	0.5146	0.5267	0.5206	7288.
47434	0.5272	0.5376	0.5324	7261.
48111	0.5399	0.5488	0.5444	7275.
48842	0.5534	0.5595	0.5565	7275.
49568	0.5662	0.5660	0.5661	7275.
50294	0.5764	0.5762	0.5773	7275.
51033	0.5886	0.5915	0.5900	7261.
51761	0.6009	0.5997	0.6003	7261.
52488	0.6131	0.6062	0.6097	7261.
53215	0.6255	0.6194	0.6219	7315.
53942	0.6369	0.6292	0.6330	7261.
54669	0.6496	0.6361	0.6429	7248.
55396	0.6627	0.6471	0.6549	7248.
56123	0.6750	0.6602	0.6661	7261.
56850	0.6872	0.6714	0.6780	7248.
57577	0.6997	0.6837	0.6902	7248.
58304	0.7022	0.6979	0.7010	7261.
59031	0.7143	0.7019	0.7101	7288.
59758	0.7267	0.7091	0.7207	7275.
60485	0.7390	0.7313	0.7330	7248.
61212	0.7514	0.7312	0.7430	7288.
61939	0.7638	0.7500	0.7560	7248.
62666	0.7762	0.7525	0.7670	7248.
63393	0.7886	0.7651	0.7790	7275.
64120	0.8010	0.7728	0.7894	7261.
64847	0.8134	0.7840	0.8013	7275.
65574	0.8258	0.7980	0.8139	7275.
66301	0.8382	0.8117	0.8270	7261.
67028	0.8506	0.8255	0.8399	7248.
67755	0.8630	0.8350	0.8516	7248.
68482	0.8754	0.8490	0.8649	7251.
69209	0.8878	0.8632	0.8762	7261.
69936	0.9002	0.8777	0.8889	7261.
70663	0.9126	0.8902	0.9014	7261.
71390	0.9250	0.9026	0.9146	7248.
72117	0.9374	0.9150	0.9294	7248.
72844	0.9498	0.9274	0.9422	7275.
73571	0.9622	0.9398	0.9552	7275.
74298	0.9746	0.9524	0.9690	7261.
75025	0.9870	0.9649	0.9814	7261.
75752	0.9994	0.9774	0.9928	7248.
76479	1.0118	0.9899	1.0052	7261.
77206	1.0242	0.9999	1.0142	7261.
77933	1.0366	1.0099	1.0272	7248.
78660	1.0490	1.0199	1.0402	7248.
79387	1.0614	1.0299	1.0526	7261.
80114	1.0738	1.0399	1.0650	7261.
80841	1.0862	1.0499	1.0774	7248.
81568	1.0986	1.0599	1.0898	7248.
82295	1.1110	1.0699	1.1022	7261.
83022				

TABLE 5-13. CRACK GROWTH DATA SPECIMEN GT160KA849-03 S/N 4

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
6-96	0.3122	0.3321	11965.	0.496
11369.	0.3174	0.3436	11956.	0.495
16356.	0.3286	0.3580	11973.	0.497
21358.	0.3398	0.3692	11965.	0.497
26661.	0.3425	0.3826	11954.	0.496
30236.	0.3528	0.3964	11996.	0.496
33850.	0.3618	0.4102	12017.	0.498
37669.	0.3715	0.3976	11996.	0.496
41345.	0.3711	0.4373	11965.	0.497
45296.	0.3869	0.4472	11996.	0.496
47615.	0.3964	0.4591	11973.	0.499
50176.	0.4075	0.4390	11965.	0.496
53225.	0.4190	0.4515	11973.	0.496
56269.	0.4304	0.4926	11986.	0.497
59280.	0.4418	0.5041	11965.	0.498
62840.	0.4593	0.5185	11965.	0.496
65374.	0.4807	0.5392	11973.	0.497
67528.	0.4869	0.5723	11986.	0.496
68632.	0.4975	0.5860	11956.	0.499
70379.	0.5089	0.5933	11986.	0.497
71969.	0.5171	0.6070	11973.	0.495
72577.	0.5229	0.6212	11973.	0.497
74189.	0.5344	0.6303	11954.	0.496
75638.	0.5426	0.6440	11954.	0.497
77411.	0.5503	0.6585	11986.	0.496
78017.	0.5620	0.6700	11965.	0.498
79812.	0.5736	0.6788	11973.	0.496
80810.	0.5811	0.6943	11965.	0.497
81946.	0.5894	0.7104	11965.	0.497
83374.	0.6009	0.7189	11944.	0.499
84208.	0.6061	0.7320	11954.	0.497
85361.	0.6158	0.7449	11944.	0.499
86812.	0.6283	0.7552	11944.	0.500
87490.	0.6361	0.7702	11933.	0.498
88394.	0.6433	0.7836	11954.	0.497
89784.	0.6553	0.7980	11965.	0.497
90721.	0.6607	0.8128	11944.	0.498
91246.	0.6730	0.8274	11944.	0.500
92249.	0.6848	0.8345	11944.	0.499
92936.	0.6922	0.8483	11954.	0.497
93793.	0.7043	0.8642	11923.	0.500
94766.	0.7161	0.8748	11933.	0.501
95828.	0.7283	0.8831	11933.	0.497
96689.	0.7372	0.9025	11944.	0.498
97426.	0.7489	0.9133	11954.	0.499
98165.	0.7591	0.9219	11944.	0.500
99012.	0.7679	0.9244	11933.	0.498
99549.	0.7800	0.9530	11954.	0.496
100568.	0.7913	0.9692	11933.	0.498
101491.	0.7995	0.9836	11944.	0.497
102512.	0.8077	0.9976	11933.	0.497
103533.	0.8121	0.9960	11935.	0.497
104554.	0.8248	1.0098	11944.	0.498
105575.	0.8323	1.0247	11954.	0.499
106596.	0.8450	1.0399	11954.	0.499
107617.	0.8573	1.0556	11933.	0.498
108638.	0.8633	1.0721	11923.	0.497
109659.	0.8763	1.0849	11933.	0.497
110680.	0.8864	1.0999	11944.	0.498
111701.	0.8936	1.1152	11944.	0.499
112722.	0.9072	1.1279	11933.	0.498
113743.	0.9158	1.1417	11923.	0.497
114764.	0.9281	1.1498	11954.	0.497
115785.	0.9411	1.1636	11933.	0.499
116806.	0.9570	1.1765	11933.	0.501
117827.	0.9694	1.1919	11933.	0.500
118848.	0.9782	1.2078	11923.	0.500
119869.	0.9878	1.2221	11923.	0.499
120890.	1.0000	1.2366	11944.	0.499
121911.	1.0057	1.2598	11944.	0.499
122932.	1.0187	1.2867	11944.	0.499
123953.	1.0272	1.2816	11923.	0.499
124974.	1.0393	1.2945	11944.	0.500
125995.	1.0506	1.3102	11923.	0.500
127016.	1.0639	1.3249	11933.	0.497
128037.	1.0744	1.3414	11933.	0.498
129058.	1.0811	1.3590	11933.	0.498
130079.	1.0916	1.3794	11933.	0.500
131100.	1.1032	1.3970	11933.	0.497
132121.	1.1103	1.4132	11933.	0.497
133142.	1.1204	1.4297	11933.	0.499
134163.	1.1304	1.4486	11944.	0.499
135184.	1.1470	1.4580	11944.	0.499
136205.	1.1574	1.4748	11923.	0.500
137226.	1.1695	1.4915	11944.	0.498
138247.	1.1764	1.5080	11933.	0.498
139268.	1.1850	1.5271	11944.	0.498
140289.	1.1996	1.5419	11923.	0.500
141310.	1.2148	1.5559	11923.	0.500
142331.	1.2348	1.5789	11923.	0.500

TABLE 5-14. CRACK GROWTH DATA SPECIMEN GT160KAB49-23 S/N 1

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
32551	0.2909	0.2730	7001.	- 301
32552	0.3030	0.2746	7022.	- 300
32553	0.3149	0.2826	6991.	- 301
32554	0.3270	0.2906	7001.	- 299
32555	0.3392	0.2937	7001.	- 301
32556	0.3512	0.2991	6991.	- 303
32557	0.3630	0.3011	7033.	- 299
32558	0.3760	0.3224	7012.	- 299
32559	0.3890	0.3421	7012.	- 299
32560	0.4023	0.3627	7033.	- 300
32561	0.4159	0.3832	7012.	- 300
32562	0.4298	0.4044	7012.	- 299
32563	0.4439	0.4266	7012.	- 301
32564	0.4581	0.4496	7012.	- 302
32565	0.4725	0.4718	7012.	- 300
32566	0.4870	0.4942	7012.	- 300
32567	0.5016	0.5173	7012.	- 301
32568	0.5164	0.5404	7012.	- 300
32569	0.5313	0.5635	7012.	- 300
32570	0.5463	0.5866	7012.	- 299
32571	0.5614	0.6097	7012.	- 299
32572	0.5765	0.6328	7012.	- 301
32573	0.5917	0.6559	7012.	- 300
32574	0.6070	0.6790	7012.	- 300
32575	0.6224	0.7021	7012.	- 299
32576	0.6378	0.7252	7012.	- 299
32577	0.6533	0.7483	7012.	- 298
32578	0.6688	0.7714	7012.	- 298
32579	0.6843	0.7945	7012.	- 298
32580	0.6998	0.8176	7012.	- 298
32581	0.7153	0.8407	7012.	- 298
32582	0.7308	0.8638	7012.	- 298
32583	0.7463	0.8869	7012.	- 298
32584	0.7618	0.9100	7012.	- 298
32585	0.7773	0.9331	7012.	- 298
32586	0.7928	0.9562	7012.	- 298
32587	0.8083	0.9793	7012.	- 298
32588	0.8238	1.0024	7012.	- 298
32589	0.8393	1.0255	7012.	- 298
32590	0.8548	1.0486	7012.	- 298
32591	0.8703	1.0717	7012.	- 298
32592	0.8858	1.0948	7012.	- 298
32593	0.9013	1.1179	7012.	- 298
32594	0.9168	1.1410	7012.	- 298
32595	0.9323	1.1641	7012.	- 298
32596	0.9478	1.1872	7012.	- 298
32597	0.9633	1.2103	7012.	- 298
32598	0.9788	1.2334	7012.	- 298
32599	0.9943	1.2565	7012.	- 298
32600	1.0098	1.2796	7012.	- 298
32601	1.0253	1.3027	7012.	- 298
32602	1.0408	1.3258	7012.	- 298
32603	1.0563	1.3489	7012.	- 298
32604	1.0718	1.3720	7012.	- 298
32605	1.0873	1.3951	7012.	- 298
32606	1.1028	1.4182	7012.	- 298
32607	1.1183	1.4413	7012.	- 298
32608	1.1338	1.4644	7012.	- 298
32609	1.1493	1.4875	7012.	- 298
32610	1.1648	1.5106	7012.	- 298
32611	1.1803	1.5337	7012.	- 298
32612	1.1958	1.5568	7012.	- 298
32613	1.2113	1.5799	7012.	- 298
32614	1.2268	1.6030	7012.	- 298
32615	1.2423	1.6261	7012.	- 298
32616	1.2578	1.6492	7012.	- 298
32617	1.2733	1.6723	7012.	- 298
32618	1.2888	1.6954	7012.	- 298
32619	1.3043	1.7185	7012.	- 298
32620	1.3198	1.7416	7012.	- 298
32621	1.3353	1.7647	7012.	- 298
32622	1.3508	1.7878	7012.	- 298
32623	1.3663	1.8109	70	

TABLE 5-15. CRACK GROWTH DATA SPECIMEN GT160KAB49-23 S/N 2

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO	
	LEFT	RIGHT			
1541	0.3119	0.2930	0.3024	-300	11971.
2403	0.3227	0.3073	0.3150	-300	11950.
3189	0.3358	0.3219	0.3288	-300	11950.
4365	0.3501	0.3346	0.3424	-299	11981.
5161	0.3599	0.3496	0.3548	-300	11981.
5781	0.3732	0.3593	0.3662	-299	11971.
6579	0.3865	0.3691	0.3778	-300	11950.
7374	0.4016	0.3805	0.3910	-299	11982.
8129	0.4142	0.3998	0.4050	-298	12002.
8680	0.4273	0.4165	0.4154	-302	11981.
9127	0.4403	0.4241	0.4257	-299	11992.
9957	0.4534	0.4378	0.4341	-299	12002.
10091	0.4669	0.4430	0.4482	-300	11971.
10819	0.4806	0.4628	0.4599	-300	11950.
11233	0.4921	0.4777	0.4731	-300	11971.
11683	0.5065	0.4871	0.4847	-302	11971.
12256	0.5214	0.5062	0.4991	-299	11971.
12648	0.5378	0.5312	0.5158	-298	11981.
13155	0.5522	0.5490	0.5354	-300	11960.
13755	0.5667	0.5672	0.5497	-300	11971.
14199	0.5815	0.5731	0.5609	-299	11960.
14576	0.5942	0.5869	0.5752	-298	11981.
15056	0.6083	0.5913	0.5913	-300	11981.
15467	0.6256	0.6037	0.6037	-300	11981.
15915	0.6421	0.6163	0.6163	-298	11971.
16395	0.6594	0.6300	0.6300	-298	11981.
16875	0.6780	0.6587	0.6587	-298	11971.
17459	0.6961	0.6888	0.6725	-300	11981.
18077	0.7145	0.7018	0.6862	-298	11960.
18556	0.7329	0.7145	0.6991	-299	11950.
19108	0.7513	0.7295	0.7138	-299	11971.
19553	0.7700	0.7468	0.7251	-296	11981.
19753	0.7887	0.7730	0.7533	-299	11971.
20132	0.8066	0.7950	0.7826	-297	11971.
20508	0.8244	0.8066	0.7845	-298	11981.
21299	0.8421	0.8203	0.7854	-299	11960.
21744	0.8599	0.8371	0.8008	-299	11971.
22332	0.8774	0.8515	0.8145	-300	11960.
22813	0.8954	0.8603	0.8253	-299	11971.
23258	0.9133	0.8712	0.8374	-300	11971.
23773	0.9312	0.8891	0.8490	-299	11971.
24461	0.9491	0.9052	0.8614	-299	11971.
24904	0.9667	0.9237	0.8752	-298	11981.
25389	0.9842	0.9425	0.8909	-298	11971.
25853	1.0017	0.9607	0.9057	-299	11971.
26106	1.0192	0.9784	0.9228	-296	11981.
26482	1.0367	0.9959	0.9403	-300	11950.
26857	1.0542	1.0140	0.9541	-298	11971.
27198	1.0717	1.0320	0.9786	-300	11950.
27577	1.0892	1.0499	0.9939	-301	11971.
27952	1.1067	1.0674	0.9986	-296	11971.

TABLE 5-20. CRACK GROWTH DATA SPECIMEN GT160KAB49-07 S/N 3

CYCLE #	CRACK LENGTH (INS)			MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT	AVERAGE		
19466	0.2508	0.2791	0.2700	8937	0.500
53443	0.2652	0.2943	0.2798	8919	0.500
92051	0.2660	0.3118	0.2889	9007	0.500
125611	0.2664	0.3258	0.2961	8989	0.500
173534	0.2680	0.3405	0.3043	9007	0.500
192549	0.2796	0.3489	0.3142	8989	0.500
211856	0.2972	0.3559	0.3265	8989	0.500
225070	0.3104	0.3632	0.3368	9007	0.500
259262	0.3272	0.3699	0.3486	8972	0.500
297188	0.3316	0.3846	0.3581	8972	0.500
332758	0.3424	0.3986	0.3705	8969	0.500
357139	0.3496	0.4126	0.3811	8972	0.500
377980	0.3620	0.4266	0.3943	8972	0.500
398015	0.3740	0.4363	0.4051	9007	0.500
412011	0.3816	0.4513	0.4165	9007	0.500
424218	0.3956	0.4633	0.4295	8972	0.500
437728	0.4028	0.4773	0.4401	9007	0.500
453748	0.4148	0.4863	0.4506	8972	0.500
473921	0.4200	0.5003	0.4602	8972	0.500
484407	0.4276	0.5147	0.4712	8972	0.500
492556	0.4380	0.5290	0.4835	8972	0.500
481910	0.4424	0.5431	0.4927	8972	0.500
488023	0.4476	0.5571	0.5024	8972	0.500
493330	0.4520	0.5711	0.5116	8972	0.500
496841	0.4560	0.5851	0.5206	8972	0.500
503030	0.4663	0.5961	0.5313	8954	0.500
509781	0.4725	0.6101	0.5413	8954	0.500
513248	0.4881	0.6195	0.5538	8954	0.500
513300	0.4897	0.6338	0.5617	8954	0.500
520339	0.4940	0.6482	0.5711	8937	0.500
524391	0.5019	0.6622	0.5825	8972	0.500
526937	0.5061	0.6762	0.5911	8972	0.500
530430	0.5085	0.6909	0.5997	8934	0.500
534732	0.5169	0.7049	0.6109	8954	0.500
537078	0.5189	0.7189	0.6159	8954	0.500
538871	0.5209	0.7329	0.6269	8937	0.500
541413	0.5273	0.7469	0.6371	8937	0.500
545579	0.5393	0.7586	0.6489	8937	0.500
545831	0.5421	0.7729	0.6575	8937	0.500
546482	0.5433	0.7870	0.6651	8919	0.500
547311	0.5457	0.8010	0.6733	8919	0.500
548263	0.5501	0.8150	0.6825	8937	0.500
548864	0.5517	0.8293	0.6905	8937	0.500
549609	0.5541	0.8437	0.6999	8919	0.500
550206	0.5557	0.8580	0.7069	8919	0.500
551055	0.5597	0.8720	0.7159	8919	0.500
551577	0.5629	0.8861	0.7245	8919	0.500
552101	0.5649	0.9004	0.7326	8919	0.500
552380	0.5653	0.9144	0.7398	8919	0.500
552960	0.5677	0.9284	0.7481	8919	0.500

TABLE 5-21. CRACK GROWTH DATA SPECIMEN GT160KAB49-07 S/N 4

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT AVERAGE		
1.	0.2520	0.2564	13772.	0.500
11107.	0.2553	0.2667	12498.	0.500
16807.	0.2579	0.2769	12498.	0.500
22787.	0.2613	0.2872	12465.	0.500
26003.	0.2691	0.2945	12480.	0.500
35445.	0.2684	0.3055	12480.	0.500
40238.	0.2765	0.3072	12463.	0.500
43430.	0.2843	0.3087	12480.	0.500
45322.	0.2858	0.3189	12463.	0.500
49178.	0.2992	0.3292	12480.	0.500
33509.	0.2925	0.3395	12463.	0.500
38631.	0.2925	0.3497	12480.	0.500
48137.	0.2970	0.3600	12463.	0.500
72470.	0.3007	0.3702	12445.	0.500
79509.	0.3085	0.3771	12393.	0.500
83507.	0.3155	0.3873	12393.	0.500
87959.	0.3182	0.3976	12393.	0.500
92836.	0.3126	0.4079	12393.	0.500
101395.	0.3204	0.4167	12393.	0.500
107130.	0.3282	0.4230	12293.	0.500
112819.	0.3278	0.4333	12393.	0.500
118319.	0.3360	0.4386	12393.	0.500
120106.	0.3371	0.4489	12393.	0.500
123911.	0.3449	0.4567	12393.	0.500
130952.	0.3516	0.4670	12393.	0.500
136522.	0.3594	0.4709	12393.	0.500
138838.	0.3680	0.4714	12410.	0.500
142058.	0.3758	0.4719	12393.	0.500
144983.	0.3836	0.4758	12393.	0.500
146727.	0.3914	0.4811	12393.	0.500
149082.	0.3992	0.4855	12393.	0.500

TABLE 5-22. CRACK GROWTH DATA SPECIMEN GT160KAB49-27 S/N 1

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO	AVERAGE
	LEFT	RIGHT			
60033.	0.2569	0.2428	8694.	- 304	
92320.	0.2249	0.2391	8681.	- 313	
098537.	0.2937	0.2688	8700.	- 315	
31524.	0.2435	0.2791	8906	- 303	
465330.	0.3311	0.2482	8925	- 303	
68103.	0.3501	0.2503	8906	- 307	
80672.	0.3630	0.2533	8963.	- 303	
50298.	0.3819	0.3188	8981.	- 301	
10827.	0.3960	0.2588	8906	- 309	
26191.	0.4125	0.2619	8906.	- 305	
09494.	0.4288	0.2649	8869.	- 313	
43477.	0.4280	0.2681	869.	- 111	
46709.	0.4333	0.2711	9731.	- 304	
50670.	0.4393	0.2741	9713.	- 303	
5334.	0.4468	0.2773	9731.	- 303	
33994.	0.4505	0.2805	9731.	- 303	
59139.	0.4567	0.2838	9731.	- 301	
6026.	0.4633	0.2869	9769.	- 307	
68491.	0.4758	0.2900	9769	- 308	
74135.	0.4841	0.2931	9694.	- 308	
50850.	0.5028	0.2982	9713.	- 307	
83630.	0.5142	0.2993	9750.	- 304	
94681.	0.5238	0.3024	9694.	- 306	
93074.	0.5303	0.3055	9713.	- 306	
96105.	0.5363	0.3086	9769.	- 303	
99147.	0.5433	0.3118	9731.	- 306	
02569.	0.5528	0.3150	9713.	- 303	
00429.	0.5558	0.3184	9713.	- 301	
06224.	0.5654	0.3216	9731.	- 304	
10181.	0.5736	0.3247	9713.	- 305	
11979.	0.5821	0.3278	9731.	- 301	
13848.	0.5897	0.3311	9731.	- 301	
16146.	0.6087	0.3341	9713.	- 303	
18895.	0.6190	0.3371	9769.	- 305	
22147.	0.6263	0.3404	9656.	- 205	
23139.	0.6411	0.3437	8694.	- 204	
26533.	0.6445	0.3471	9713.	- 305	
27812.	0.6495	0.3503	9731.	- 301	
29087.	0.6565	0.3535	9769.	- 303	
30466.	0.6606	0.3563	9694.	- 302	
31559.	0.6671	0.3601	9731.	- 301	
36502.	0.6722	0.3634	9769.	- 303	
33615.	0.6746	0.3668	9713.	- 299	
37238.	0.6844	0.3703	9731.	- 299	
38585.	0.6872	0.3731	9731.	- 306	
39410.	0.6898	0.3772	9731.	- 303	
40264.	0.6926	0.3808	9694.	- 309	
41132.	0.6962	0.3843	9713.	- 305	
42304.	0.7056	0.3877	9750	- 302	
43164.	0.7084	0.3909	9731.	- 304	
44269.	0.7151	0.3943	9731.	- 303	
45241.	0.7266	0.3977	9731.	- 304	

TABLE 5-23. CRACK GROWTH DATA SPECIMEN GT160KAB49-27 S/N 2

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO	YAX STRESS (PSI)	STRESS RATIO	YAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT						
3248	0.2111	0.2142	0.2127	- .305	12056.	- .305	52550.	- .305
6687	0.2162	0.2250	0.2206	- .303	12056.	- .303	52718.	- .303
10301	0.2187	0.2363	0.2275	- .301	12075.	- .301	52851.	- .301
15024	0.2260	0.2483	0.2372	- .305	12094.	- .305	52950.	- .307
18111	0.2329	0.2600	0.2464	- .305	12056.	- .305		
19981	0.2435	0.2661	0.2548	- .306	12056.	- .306		
20709	0.2348	0.2688	0.2618	- .309	12056.	- .309		
21607	0.2653	0.2731	0.2693	- .306	12056.	- .306		
22468	0.2766	0.2776	0.2772	- .310	12038.	- .310		
23503	0.2877	0.2794	0.2836	- .303	12056.	- .303		
25303	0.2991	0.2865	0.2928	- .305	12094.	- .305		
25993	0.3099	0.2901	0.3000	- .307	12019.	- .307		
27173	0.3206	0.2964	0.3085	- .305	12056.	- .305		
28553	0.3317	0.3069	0.3193	- .306	12075.	- .306		
29416	0.3409	0.3146	0.3277	- .302	12056.	- .302		
30833	0.3325	0.3205	0.3265	- .309	12019.	- .309		
32190	0.3635	0.3261	0.3448	- .305	12038.	- .305		
33170	0.3737	0.3352	0.3548	- .307	12019.	- .307		
34909	0.3852	0.3432	0.3642	- .305	12038.	- .305		
36610	0.3965	0.3501	0.3732	- .305	12056.	- .305		
36879	0.4077	0.3622	0.3850	- .301	12094.	- .301		
37670	0.4189	0.3718	0.3955	- .305	12094.	- .305		
38290	0.4312	0.3753	0.4032	- .304	12019.	- .304		
39359	0.4425	0.3853	0.4139	- .305	12038.	- .305		
40150	0.4325	0.3974	0.4150	- .305	12056.	- .305		
40812	0.4440	0.4043	0.4241	- .304	12038.	- .304		
41734	0.4751	0.4145	0.4448	- .305	12056.	- .305		
42595	0.4861	0.4241	0.4551	- .302	12094.	- .302		
43351	0.4969	0.4322	0.4646	- .308	12000.	- .308		
44073	0.5089	0.4438	0.4763	- .304	12038.	- .304		
44656	0.5164	0.4564	0.4864	- .307	12074.	- .307		
45241	0.5265	0.4698	0.4982	- .307	12038.	- .307		
45886	0.5320	0.4825	0.5073	- .303	12056.	- .303		
46269	0.5408	0.4963	0.5196	- .306	12019.	- .306		
46783	0.5535	0.5080	0.5307	- .302	12056.	- .302		
47193	0.5659	0.5206	0.5433	- .306	12056.	- .306		
47638	0.5768	0.5347	0.5558	- .307	12038.	- .307		
48120	0.5883	0.5449	0.5666	- .306	12056.	- .306		
48576	0.6006	0.5545	0.5776	- .300	12075.	- .300		
48803	0.6100	0.5692	0.5896	- .304	12038.	- .304		
49179	0.6209	0.5836	0.6022	- .305	12075.	- .305		
49486	0.6335	0.5982	0.6158	- .305	12056.	- .305		
49828	0.6434	0.6143	0.6298	- .308	12056.	- .308		
50203	0.6550	0.6310	0.6430	- .305	12038.	- .305		
50615	0.6643	0.6501	0.6572	- .306	12056.	- .306		
50887	0.6756	0.6682	0.6719	- .306	12019.	- .306		
51228	0.6844	0.6843	0.6843	- .305	12056.	- .305		
51531	0.6953	0.7000	0.6976	- .306	12019.	- .306		
51703	0.7087	0.7187	0.7137	- .307	12038.	- .307		
51940	0.7193	0.7244	0.7268	- .307	12019.	- .307		
52144	0.7352	0.7479	0.7416	- .309	12019.	- .309		
52416	0.7502	0.7590	0.7546	- .304	12138.	- .304		

TABLE 5-24. CRACK GROWTH DATA SPECIMEN GT160KAB49-27 S/N 3

CYCLE #	CRACK LENGTH (INS)			MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT	AVERAGE		
39071	0.2415	0.2611	0.2513	7219	-504
86672	0.2510	0.2784	0.2647	7219	-496
127653	0.2604	0.2931	0.2767	7200	-503
156865	0.2700	0.3034	0.2867	7256	-501
178247	0.2794	0.3104	0.2949	7219	-501
192658	0.2869	0.3161	0.3025	7238	-505
203312	0.2965	0.3212	0.3098	7181	-507
214577	0.3061	0.3253	0.3167	7256	-499
224633	0.3178	0.3290	0.3234	7219	-504
234411	0.3274	0.3323	0.3298	7200	-506
247666	0.3371	0.3376	0.3373	7228	-503
261432	0.3465	0.3422	0.3444	7219	-504
273553	0.3561	0.3472	0.3517	7215	-501
277542	0.3636	0.3507	0.3562	8369	-503
281077	0.3754	0.3582	0.3668	8369	-508
284927	0.3851	0.3656	0.3753	8350	-509
289173	0.4046	0.3932	0.3989	8531	-514
297101	0.4136	0.4153	0.4145	8531	-512
305144	0.4234	0.4320	0.4277	8513	-515
311974	0.4300	0.4543	0.4437	8513	-515
319974	0.4427	0.4736	0.4581	8550	-502
326842	0.4535	0.4678	0.4700	8831	-490
332255	0.4619	0.5005	0.4812	8794	-490
339762	0.4717	0.5172	0.4944	8831	-493
342250	0.4813	0.5292	0.5053	8831	-493
345431	0.4911	0.5428	0.5169	8775	-496
347713	0.5007	0.5553	0.5280	8813	-489
351095	0.5105	0.5629	0.5367	8813	-491
351644	0.5232	0.5597	0.5465	8888	-485
353178	0.5412	0.5713	0.5562	8775	-491
353334	0.5613	0.5936	0.5774	8813	-489
355356	0.5697	0.6177	0.5937	8775	-491
356410	0.5817	0.6284	0.6051	8813	-487
357411	0.5820	0.6525	0.6172	8988	-481
358228	0.5952	0.6643	0.6298	8775	-500
359242	0.6066	0.6814	0.6440	8775	-489
360079	0.6163	0.6963	0.6563	8631	-486
360926	0.6277	0.7160	0.6719	8775	-494
361288	0.6381	0.7261	0.6821	8794	-490
361713	0.6492	0.7379	0.6935	8813	-491
362257	0.6608	0.7471	0.7039	8775	-489
362904	0.6720	0.7692	0.7206	8736	-490
363443	0.6843	0.7837	0.7340	8510	-487
363978	0.6955	0.8019	0.7487	8775	-491
364473	0.7069	0.8174	0.7621	8924	-492
364972	0.7184	0.8400	0.7792	8831	-490
365243	0.7295	0.8586	0.7930	8775	-492
365683	0.7415	0.8770	0.8092	8775	-492
366079	0.7509	0.9055	0.8282	8775	-487

TABLE 5-25. CRACK GROWTH DATA SPECIMEN GT160KAB49-27 S/N 4

CYCLE #	CRACK LENGTH (INS)			MAX STRESS (PSI)	STRESS RATIO	
	LEFT	RIGHT	AVERAGE			
2310	0.2106	0.2085	0.2096	12168.	-497	12113.
3769	0.2175	0.2108	0.2141	12131.	-499	12131.
5303	0.2246	0.2134	0.2190	12131.	-499	12113.
6823	0.2317	0.2154	0.2235	12094.	-498	12131.
8143	0.2386	0.2178	0.2282	12131.	-493	12131.
9635	0.2459	0.2210	0.2335	12113.	-497	12131.
11344	0.2531	0.2247	0.2389	12094.	-502	12113.
12926	0.2604	0.2280	0.2442	12113.	-497	12169.
14214	0.2673	0.2306	0.2489	12113.	-498	12113.
16340	0.2744	0.2351	0.2548	12169	-498	12131.
17266	0.2827	0.2361	0.2594	12131.	-499	12150.
19012	0.2900	0.2399	0.2649	12094.	-498	12113.
20035	0.2974	0.2433	0.2703	12094.	-499	12113.
21002	0.3047	0.2472	0.2760	12113.	-498	12113.
21864	0.3128	0.2507	0.2818	12131.	-498	12094.
22796	0.3208	0.2532	0.2870	12150.	-497	12094.
24040	0.3287	0.2568	0.2928	12150.	-494	12094.
25356	0.3366	0.2626	0.2996	12150.	-497	12094.
26739	0.3446	0.2690	0.3068	12094.	-499	12113.
28449	0.3527	0.2773	0.3150	12131.	-501	12131.
30840	0.3607	0.2863	0.3235	12131.	-496	12094.
32156	0.3687	0.3059	0.3373	12131.	-499	12113.
32890	0.3765	0.3169	0.3467	12169.	-495	12094.
33823	0.3842	0.3271	0.3556	12113.	-497	12094.
34827	0.3928	0.3348	0.3638	12131.	-498	12094.
35825	0.4006	0.3461	0.3734	12113.	-497	12113.
36563	0.4089	0.3577	0.3773	12113.	-498	12113.
37460	0.4166	0.3660	0.3913	12131.	-501	12131.
37564	0.4242	0.3792	0.3927	12094.	-500	12094.
38334	0.4326	0.3966	0.4146	12094.	-502	12094.
39459	0.4416	0.4076	0.4246	12075.	-503	12094.
40237	0.4503	0.4197	0.4350	12113.	-500	12094.
41173	0.4582	0.4287	0.4435	12113.	-500	12094.
42068	0.4664	0.4390	0.4527	12131.	-499	12113.
42925	0.4745	0.4498	0.4621	12131.	-502	12113.
43639	0.4827	0.4607	0.4717	12131.	-496	12113.
44329	0.4909	0.4798	0.4854	12150.	-495	12113.
45392	0.5007	0.4849	0.4928	12131.	-498	12113.
46072	0.5088	0.4972	0.5030	12113.	-494	12094.
46759	0.5163	0.5058	0.5111	12150.	-495	12094.
46827	0.5245	0.5077	0.5161	12094.	-501	12094.
47776	0.5327	0.5158	0.5243	12113.	-500	12094.
48408	0.5409	0.5272	0.5341	12131.	-498	12094.
48991	0.5490	0.5372	0.5431	12094.	-501	12094.
49746	0.5571	0.5461	0.5516	12131.	-498	12094.
50984	0.5651	0.5513	0.5582	12094.	-501	12094.
50724	0.5732	0.5601	0.5667	12131.	-501	12094.
50873	0.5814	0.5688	0.5751	12150.	-497	12094.
51119	0.5896	0.5769	0.5833	12113.	-500	12075.
51799	0.5979	0.5856	0.5918	12150.	-495	201.

TABLE 5-26. CRACK GROWTH DATA SPECIMEN GT10KAB49-05 S/N 1

CYCLE	CRACK LENGTH (INS)		MAX. STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
1	0.2840	0.2460	6751	0.350
3622	0.2868	0.2748	6751	0.350
7111	0.2902	0.2876	6751	0.350
27359	0.2968	0.2926	6695	0.350
26312	0.3032	0.3021	6695	0.350
44672	0.3119	0.3098	6676	0.350
31363	0.3163	0.3161	6713	0.350
34351	0.3229	0.3222	6676	0.350
44336	0.3297	0.3281	6713	0.350
76537	0.3361	0.3343	6695	0.350
75109	0.3433	0.3419	6713	0.350
31021	0.3497	0.3475	6695	0.350
44204	0.3553	0.3543	6713	0.350
81982	0.3593	0.3529	6676	0.350
369913	0.3649	0.3573	6695	0.350
94449	0.3727	0.3715	6713	0.350
97610	0.3781	0.3840	6713	0.350
3989	0.3942	0.3896	6695	0.350
53375	0.3992	0.3966	6695	0.350
33787	0.4076	0.4044	6695	0.350
98481	0.4082	0.4110	6676	0.350
11325	0.4123	0.4178	6695	0.350
14081	0.4168	0.4248	6713	0.350
14081	0.4238	0.4326	6676	0.350
20547	0.4340	0.4402	6713	0.350
22334	0.4419	0.4449	6676	0.350
22336	0.4511	0.4537	6676	0.350
2767	0.4633	0.4613	6695	0.350
29191	0.4711	0.4679	6695	0.350
30710	0.4833	0.4793	6676	0.350
31089	0.4711	0.4807	6676	0.350
33223	0.4907	0.4881	6676	0.350
34421	0.4939	0.4945	6676	0.350
34566	0.4971	0.5007	6695	0.350
44323	0.5033	0.5096	6676	0.350
44323	0.5119	0.5135	6676	0.350
44323	0.5200	0.5212	6676	0.350
44323	0.5284	0.5274	6676	0.350
44323	0.5324	0.5326	6676	0.350
44323	0.5388	0.5382	6676	0.350
44323	0.5440	0.5466	6676	0.350
44323	0.5570	0.5570	6676	0.350
44323	0.5625	0.5625	6695	0.350
44323	0.5712	0.5726	6695	0.350
44323	0.5801	0.5802	6676	0.350
44323	0.5825	0.5825	6676	0.350
44323	0.5897	0.5897	6676	0.350
44323	0.5909	0.5909	6676	0.350
44323	0.6009	0.6009	6676	0.350
44323	0.6172	0.6172	6676	0.350
44323	0.6251	0.6251	6676	0.350
44323	0.6307	0.6307	6695	0.350
44323	0.6377	0.6377	6695	0.350
44323	0.6439	0.6439	6695	0.350
44323	0.6500	0.6500	6695	0.350
44323	0.6561	0.6561	6695	0.350
44323	0.6622	0.6622	6695	0.350
44323	0.6683	0.6683	6695	0.350
44323	0.6744	0.6744	6695	0.350
44323	0.6805	0.6805	6695	0.350
44323	0.6866	0.6866	6695	0.350
44323	0.6927	0.6927	6695	0.350
44323	0.6988	0.6988	6695	0.350
44323	0.7049	0.7049	6695	0.350
44323	0.7110	0.7110	6695	0.350
44323	0.7171	0.7171	6695	0.350
44323	0.7232	0.7232	6695	0.350
44323	0.7293	0.7293	6695	0.350
44323	0.7354	0.7354	6695	0.350
44323	0.7415	0.7415	6695	0.350
44323	0.7476	0.7476	6695	0.350
44323	0.7537	0.75		

TABLE 5-27. CRACK GROWTH DATA SPECIMEN GTI60KAB49-05 S/N 2

[illegible]

TABLE 5-28. CRACK GROWTH DATA SPECIMEN GT160KAB49-05 S/N 3

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO	
	LEFT	RIGHT			
1.	0.4643	0.4058	0	0.500	397764
34223	0.4733	0.4735	7733	0.500	398740
33250	0.4736	0.4738	7694	0.500	399968
39897	0.4871	0.4728	7675	0.500	-011111
0.91108	0.4912	0.4476	7675	0.500	-01-06
152293	0.4997	0.4439	7694	0.500	40-202
161233	0.5033	0.4530	7675	0.500	
168961	0.5079	0.4632	7675	0.500	
187060	0.5164	0.4666	7675	0.500	
202035	0.5197	0.4779	7675	0.500	
210232	0.5286	0.4839	7675	0.500	
229317	0.5319	0.4991	7633	0.500	
230917	0.5364	0.5102	7675	0.500	
240491	0.5412	0.5198	7675	0.500	
246238	0.5433	0.5241	7636	0.500	
254253	0.5624	0.5251	7633	0.500	
2564424	0.5705	0.5267	7636	0.500	
266730	0.5793	0.5272	7633	0.500	
270703	0.5860	0.5284	7675	0.500	
275758	0.5900	0.5272	7633	0.500	
277671	0.6031	0.5283	7636	0.500	
282749	0.6116	0.5374	7633	0.500	
286494	0.6222	0.5416	7636	0.500	
295602	0.6318	0.5516	7633	0.500	
303781	0.6422	0.5662	7636	0.500	
314801	0.6588	0.5702	7633	0.500	
319945	0.6677	0.5772	7675	0.500	
326844	0.6773	0.5830	7694	0.500	
338474	0.6842	0.5967	7633	0.500	
343462	0.6901	0.6079	7633	0.500	
348236	0.6956	0.6190	7633	0.500	
351527	0.6974	0.6302	7675	0.500	
354703	0.7039	0.6413	7675	0.500	
356949	0.7060	0.6533	7675	0.500	
364281	0.7143	0.6783	7633	0.500	
365989	0.7166	0.6875	7633	0.500	
368342	0.7202	0.6960	7633	0.500	
370640	0.7243	0.7097	7633	0.500	
373090	0.7312	0.7209	7633	0.500	
376761	0.7366	0.7220	7633	0.500	
379759	0.7435	0.7395	7675	0.500	
383211	0.7475	0.7426	7675	0.500	
384223	0.7564	0.7538	7675	0.500	
386233	0.7617	0.7649	7633	0.500	
388431	0.7680	0.7701	7633	0.500	
391281	0.7800	0.7814	7633	0.500	
392743	0.7816	0.7925	7636	0.500	
394562	0.7902	0.7978	7633	0.500	
396269	0.7963	0.8090	7633	0.500	
397730	0.7997	0.8096	7675	0.500	

TABLE 5-31. CRACK GROWTH DATA SPECIMEN GT160KAB49-25 S/N 2

CYCLE	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
1	0.2260	0.2300	0	0.217
2	0.2321	0.2388	0.2354	0.217
3	0.2362	0.2475	0.2418	0.217
4	0.2398	0.2563	0.2480	0.217
5	0.2464	0.2642	0.2563	0.217
6	0.2537	0.2729	0.2642	0.217
7	0.2579	0.2817	0.2729	0.217
8	0.2614	0.2904	0.2817	0.217
9	0.2657	0.2992	0.2904	0.217
10	0.2728	0.3074	0.2992	0.217
11	0.2815	0.3152	0.3074	0.217
12	0.2857	0.3239	0.3152	0.217
13	0.2940	0.3326	0.3239	0.217
14	0.2982	0.3413	0.3326	0.217
15	0.3065	0.3500	0.3413	0.217
16	0.3107	0.3587	0.3500	0.217
17	0.3189	0.3674	0.3587	0.217
18	0.3231	0.3761	0.3674	0.217
19	0.3273	0.3848	0.3761	0.217
20	0.3355	0.3935	0.3848	0.217
21	0.3397	0.4022	0.3935	0.217
22	0.3479	0.4109	0.4022	0.217
23	0.3521	0.4196	0.4109	0.217
24	0.3603	0.4283	0.4196	0.217
25	0.3645	0.4370	0.4283	0.217
26	0.3727	0.4457	0.4370	0.217
27	0.3769	0.4544	0.4457	0.217
28	0.3851	0.4631	0.4544	0.217
29	0.3893	0.4718	0.4631	0.217
30	0.3975	0.4805	0.4718	0.217
31	0.4017	0.4892	0.4805	0.217
32	0.4099	0.4979	0.4892	0.217
33	0.4141	0.5066	0.4979	0.217
34	0.4223	0.5153	0.5066	0.217
35	0.4265	0.5240	0.5153	0.217
36	0.4347	0.5327	0.5240	0.217
37	0.4389	0.5414	0.5327	0.217
38	0.4471	0.5501	0.5414	0.217
39	0.4513	0.5588	0.5501	0.217
40	0.4595	0.5675	0.5588	0.217
41	0.4637	0.5762	0.5675	0.217
42	0.4719	0.5849	0.5762	0.217
43	0.4761	0.5936	0.5849	0.217
44	0.4843	0.6023	0.5936	0.217
45	0.4885	0.6110	0.6023	0.217
46	0.4967	0.6197	0.6110	0.217
47	0.5009	0.6284	0.6197	0.217
48	0.5091	0.6371	0.6284	0.217
49	0.5133	0.6458	0.6371	0.217
50	0.5215	0.6545	0.6458	0.217
51	0.5257	0.6632	0.6545	0.217
52	0.5339	0.6719	0.6632	0.217
53	0.5381	0.6806	0.6719	0.217
54	0.5463	0.6893	0.6806	0.217
55	0.5505	0.6980	0.6893	0.217
56	0.5587	0.7067	0.6980	0.217
57	0.5629	0.7154	0.7067	0.217
58	0.5711	0.7241	0.7154	0.217
59	0.5753	0.7328	0.7241	0.217
60	0.5835	0.7415	0.7328	0.217
61	0.5877	0.7502	0.7415	0.217
62	0.5959	0.7589	0.7502	0.217
63	0.6001	0.7676	0.7589	0.217
64	0.6083	0.7763	0.7676	0.217
65	0.6125	0.7850	0.7763	0.217
66	0.6207	0.7937	0.7850	0.217
67	0.6249	0.8024	0.7937	0.217
68	0.6331	0.8111	0.8024	0.217
69	0.6373	0.8198	0.8111	0.217
70	0.6455	0.8285	0.8198	0.217
71	0.6497	0.8372	0.8285	0.217
72	0.6579	0.8459	0.8372	0.217
73	0.6621	0.8546	0.8459	0.217
74	0.6703	0.8633	0.8546	0.217
75	0.6745	0.8720	0.8633	0.217
76	0.6827	0.8807	0.8720	0.217
77	0.6869	0.8894	0.8807	0.217
78	0.6951	0.8981	0.8894	0.217
79	0.6993	0.9068	0.8981	0.217
80	0.7075	0.9155	0.9068	0.217
81	0.7117	0.9242	0.9155	0.217
82	0.7199	0.9329	0.9242	0.217
83	0.7241	0.9416	0.9329	0.217
84	0.7323	0.9503	0.9416	0.217
85	0.7365	0.9590	0.9503	0.217
86	0.7447	0.9677	0.9590	0.217
87	0.7489	0.9764	0.9677	0.217
88	0.7571	0.9851	0.9764	0.217
89	0.7613	0.9938	0.9851	0.217
90	0.7695	1.0025	0.9938	0.217
91	0.7737	1.0112	1.0025	0.217
92	0.7819	1.0199	1.0112	0.217
93	0.7861	1.0286	1.0199	0.217
94	0.7943	1.0373	1.0286	0.217
95	0.7985	1.0460	1.0373	0.217
96	0.8067	1.0547	1.0460	0.217
97	0.8109	1.0634	1.0547	0.217
98	0.8191	1.0721	1.0634	0.217
99	0.8233	1.0808	1.0721	0.217
100	0.8315	1.0895	1.0808	0.217
101	0.8357	1.0982	1.0895	0.217
102	0.8439	1.1069	1.0982	0.217
103	0.8481	1.1156	1.1069	0.217
104	0.8563	1.1243	1.1156	0.217
105	0.8605	1.1330	1.1243	0.217
106	0.8687	1.1417	1.1330	0.217
107	0.8729	1.1504	1.1417	0.217
108	0.8811	1.1591	1.1504	0.217
109	0.8853	1.1678	1.1591	0.217
110	0.8935	1.1765	1.1678	0.217
111	0.8977	1.1852	1.1765	0.217
112	0.9059	1.1939	1.1852	0.217
113	0.9101	1.2026	1.1939	0.217
114	0.9183	1.2113	1.2026	0.217
115	0.9225	1.2200	1.2113	0.217
116	0.9307	1.2287	1.2200	0.217
117	0.9349	1.2374	1.2287	0.217
118	0.9431	1.2461	1.2374	0.217
119	0.9473	1.2548	1.2461	0.217
120	0.9555	1.2635	1.2548	0.217
121	0.9597	1.2722	1.2635	0.217
122	0.9679	1.2809	1.2722	0.217
123	0.9721	1.2896	1.2809	0.217
124	0.9803	1.2983	1.2896	0.217
125	0.9845	1.3070	1.2983	0.217
126	0.9927	1.3157	1.3070	0.217
127	0.9969	1.3244	1.3157	0.217
128	1.0051	1.3331	1.3244	0.217
129	1.0093	1.3418	1.3331	0.217
130	1.0175	1.3505	1.3418	0.217
131	1.0217	1.3592	1.3505	0.217
132	1.0299	1.3679	1.3592	0.217
133	1.0341	1.3766	1.3679	0.217
134	1.0423	1.3853	1.3766	0.217
135	1.0465	1.3940	1.3853	0.217
136	1.0547	1.4027	1.3940	0.217
137	1.0589	1.4114	1.4027	0.217
138	1.0671	1.4201	1.4114	0.217
139	1.0713	1.4288	1.4201	0.217
140	1.0795	1.4375	1.4288	0.217
141	1.0837	1.4462	1.4375	0.217
142	1.0919	1.4549	1.4462	0.217
143	1.0961	1.4636	1.4549	0.217
144	1.1043	1.4723	1.4636	0.217
145	1.1085	1.4810	1.4723	0.217
146	1.1167	1.4897	1.4810	0.217
147	1.1209	1.4984	1.4897	0.217
148	1.1291	1.5071	1.4984	0.217
149	1.1333	1.5158	1.5071	0.217
150	1.1415	1.5245	1.5158	0.217
151	1.1457	1.5332	1.5245	0.217
152	1.1539	1.5419	1.5332	0.217
153	1.1581	1.5506	1.5419	0.217
154	1.1663	1.5593	1.5506	0.217
155	1.1705	1.5680	1.5593	0.217
156	1.1787	1.5767	1.5680	0.217
157	1.1829	1.5854	1.5767	0.217
158	1.1911	1.5941	1.5854	0.217
159	1.1953	1.6028	1.5941	0.217
160	1.2035	1.6115	1.6028	0.217
161	1.2077	1.6202	1.6115	0.217
162	1.2159	1.6289	1.6202	0.217
163	1.2201	1.6376	1.6289	0.217
164	1.2283	1.6463	1.6376	0.217
165	1.2325	1.6550	1.6463	0.217
166	1.2407	1.6637	1.6550	0.217
167	1.2449	1.6724	1.6637	0.217
168	1.2531	1.6811	1.6724	0.217
169	1.2573	1.6898	1.6811	0.217
170	1.2655	1.6985	1.6898	0.217
171	1.2697	1.7072	1.6985	0.217
172	1.2779	1.7159	1.7072	0.217
173	1.2821	1.7246	1.7159	0.217
174	1.2903	1.7333	1.7246	0.217
175	1.2945	1.7420	1.7333	0.217
176	1.3027	1.7507	1.7420	0.217
177	1.3069	1.7594	1.7507	0.217
178	1.3151	1.7681	1.7594	0.217
179	1.3193	1.7768	1.7681	0.217
180	1.3275	1.7855	1.7768	0.217
181	1.3317	1.7942	1.7855	0.217
182	1.3399	1.8029	1.7942	0.217
183	1.3441	1.8116	1.8029	0.217
184	1.3523	1.8203	1.8116	0.217
185	1.3565	1.8290	1.8203	0.217
186	1.3647	1.8377	1.8290	0.217
187	1.3689	1.8464	1.8377	0.217
188	1.3771	1.8551	1.8464	0.217
189	1.3813	1.8638	1.8551	0.217
190	1.3895	1.8725	1.8638	0.217
191	1.3937	1.8812	1.8725	0.217
192	1.4019	1.8899	1.8812	0.217
193	1.4061	1.8986	1.8899	0.217
194	1.4143	1.9073	1.8986	0.217
195	1.4185	1.9160	1.9073	0.217
196	1.4267	1.9247	1.9160	0.217
197	1.4309	1.9334	1.9247	0.217
198	1.4391	1.9421	1.9334	0.217
199	1.4433	1.9508	1.9421	0.217
200	1.4515	1.9595	1.9508	0.217
201	1.4557	1.9682	1.9595	0.217
202	1.4639	1.9769	1.9682	0.217
203	1.4681	1.9856	1.9769	0.217
204	1.4763	1.9943	1.9856	0.217
205	1.4805	2.0030	1.9943	0.217
206	1.4887	2.0117	2.0030	0.217
207	1.4929	2.0204	2.0117	0.217
208	1.5011	2.0291	2.0204	0.217
209	1.5053	2.0378	2.0291	0.217
210	1.5135	2.0465	2.0378	0.217
211	1.5177	2.0552	2.0465	0.217
212	1.5259	2.0639	2.0552	0.217
213	1.5301	2.0726	2.0639	0.217
214	1.5383	2.0813	2.0726	0.217
215	1.5425	2.0900	2.0813	0.217
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TABLE 5-32. CRACK GROWTH DATA SPECIMEN GT160KAB49-25 S/N 3

CYCLE	CRACK LENGTH (IN)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
1333	0.2535	0.2319	0.2437	114
1351	0.2646	0.2742	0.2492	306
1361	0.2710	0.2359	0.2545	306
1376	0.2816	0.2276	0.2596	306
1407	0.2871	0.2403	0.2607	307
1435	0.2876	0.2540	0.2708	307
1459	0.2944	0.2531	0.2767	306
1479	0.2949	0.2736	0.2826	306
1502	0.2764	0.2925	0.2847	300
1512	0.2981	0.2906	0.2948	301
1527	0.3076	0.2972	0.3027	303
1560	0.3165	0.3037	0.3101	306
1576	0.3253	0.3102	0.3176	306
1591	0.3340	0.3147	0.3243	301
1610	0.3427	0.3181	0.3307	304
1622	0.3519	0.3218	0.3368	301
1642	0.3607	0.3272	0.3440	303
1662	0.3693	0.3302	0.3491	304
1681	0.3753	0.3380	0.3566	304
1701	0.3826	0.3461	0.3649	304
1722	0.3912	0.3515	0.3712	306
1742	0.4002	0.3583	0.3783	307
1762	0.4090	0.3652	0.3863	303
1782	0.4179	0.3723	0.3945	303
1802	0.4269	0.3790	0.4029	306
1822	0.4359	0.3859	0.4113	306
1842	0.4449	0.3925	0.4195	306
1862	0.4539	0.4002	0.4279	306
1882	0.4629	0.4071	0.4352	306
1902	0.4719	0.4141	0.4435	304
1922	0.4809	0.4212	0.4518	301
1942	0.4899	0.4282	0.4601	301
1962	0.4989	0.4353	0.4684	303
1982	0.5079	0.4424	0.4767	306
2002	0.5169	0.4495	0.4850	306
2022	0.5259	0.4566	0.4933	306
2042	0.5349	0.4637	0.5016	309
2062	0.5439	0.4708	0.5099	303
2082	0.5529	0.4779	0.5182	303
2102	0.5619	0.4850	0.5265	306
2122	0.5709	0.4921	0.5348	306
2142	0.5799	0.4992	0.5431	307
2162	0.5889	0.5063	0.5514	301
2182	0.5979	0.5134	0.5597	310
2202	0.6069	0.5205	0.5680	306
2222	0.6159	0.5276	0.5763	306
2242	0.6249	0.5347	0.5846	301
2262	0.6339	0.5418	0.5929	309
2282	0.6429	0.5489	0.6012	306
2302	0.6519	0.5560	0.6095	304
2322	0.6609	0.5631	0.6178	306
2342	0.6699	0.5702	0.6261	306
2362	0.6789	0.5773	0.6344	306
2382	0.6879	0.5844	0.6427	306
2402	0.6969	0.5915	0.6510	306
2422	0.7059	0.5986	0.6593	306
2442	0.7149	0.6057	0.6676	306
2462	0.7239	0.6128	0.6759	306
2482	0.7329	0.6199	0.6842	306
2502	0.7419	0.6270	0.6925	306
2522	0.7509	0.6341	0.7008	306
2542	0.7599	0.6412	0.7091	306
2562	0.7689	0.6483	0.7174	306
2582	0.7779	0.6554	0.7257	306
2602	0.7869	0.6625	0.7340	306
2622	0.7959	0.6696	0.7423	306
2642	0.8049	0.6767	0.7506	306
2662	0.8139	0.6838	0.7589	306
2682	0.8229	0.6909	0.7672	306
2702	0.8319	0.6980	0.7755	306
2722	0.8409	0.7051	0.7838	306
2742	0.8499	0.7122	0.7921	306
2762	0.8589	0.7193	0.80	

TABLE 5-34. CRACK GROWTH DATA SPECIMEN GT160KA849-11 S/N 1

SPECIMEN	LIFT	CRACK LENGTH (INS)	AVERAGE	MAX STRESS, PSI	STRESS RATIO	COPD AVAILABLE TO DUCT	
						STRESS	STRAIN
1-10	0.0072	0.0175	0.0886	6823	0.050	1.0325	0.9915
1-11	0.0064	0.0166	0.0810	6857	0.047	1.0330	1.0062
1-12	0.0077	0.0111	0.0719	6877	0.032	1.0161	1.0232
1-13	0.0074	0.0100	0.0720	6850	0.047	1.0936	1.0507
1-14	0.0075	0.0112	0.0714	6840	0.047	1.0708	1.0618
1-15	0.0074	0.0110	0.0714	6840	0.044	1.0722	1.0698
1-16	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-17	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-18	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-19	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-20	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-21	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-22	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-23	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-24	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-25	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-26	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-27	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-28	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-29	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-30	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-31	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-32	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-33	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-34	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-35	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-36	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-37	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-38	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-39	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-40	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-41	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-42	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-43	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-44	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-45	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-46	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-47	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-48	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-49	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-50	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-51	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-52	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-53	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442
1-54	0.0074	0.0111	0.0714	6857	0.032	1.0351	1.0442

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TABLE 5-35. CRACK GROWTH DATA SPECIMEN 67, 68

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT AVERAGE		
729	0.3154	0.3003	11890	0.048
1376	0.3330	0.3380	11873	0.044
2060	0.3498	0.3571	11907	0.047
2753	0.3618	0.3764	11907	0.050
3314	0.3765	0.3963	11941	0.050
3928	0.3936	0.4147	11941	0.048
4482	0.4107	0.4310	11924	0.050
5030	0.4293	0.4396	11954	0.050
5647	0.4405	0.4600	11941	0.050
5964	0.4599	0.4762	11924	0.048
6377	0.4767	0.4919	11941	0.050
7032	0.4889	0.5108	11954	0.050
7409	0.5069	0.5293	11941	0.050
7823	0.5235	0.5459	11941	0.051
8408	0.5392	0.5637	11924	0.050
8977	0.5566	0.5731	11924	0.050
9567	0.5749	0.5941	11924	0.050
9918	0.5936	0.6032	11907	0.052
10366	0.6180	0.6221	11941	0.050
10744	0.6271	0.6402	11941	0.051
11144	0.6330	0.6531	11941	0.050
11565	0.6380	0.6725	11956	0.051
12012	0.6704	0.6918	11941	0.051
12412	0.6921	0.7064	11941	0.051
12719	0.7065	0.7238	11954	0.049
13001	0.7141	0.7401	11941	0.051
13270	0.7206	0.7516	11941	0.051
13581	0.7490	0.7691	11941	0.054
13757	0.7585	0.7858	11941	0.052
14099	0.7779	0.8016	11941	0.051
14329	0.7941	0.8200	11941	0.051
14852	0.8130	0.8330	11941	0.051
15132	0.8226	0.8542	11941	0.051
15467	0.8299	0.8720	11941	0.051
15704	0.8467	0.8767	11941	0.052
16012	0.8649	0.8934	11941	0.054
16332	0.8806	0.9120	11941	0.051
16633	0.8901	0.9310	11890	0.053
17175	0.9114	0.9312	11907	0.050
17354	0.9158	0.9713	11890	0.053
17792	0.9449	0.9872	11890	0.054

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permit fully legible reproduction

TABLE 5-36. CRACK GROWTH DATA SPECIMEN GT160KA849-i1 S/N 3

CIRCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
29101	0.2944	0.3171	0.3058	0.333
60046	0.3037	0.2316	0.3187	0.273
73407	0.3153	0.2468	0.3187	0.499
85013	0.3261	0.3619	0.3440	0.494
90622	0.3444	0.3749	0.3582	0.497
91529	0.4404	0.3905	0.3700	0.495
96869	0.4644	0.3994	0.3849	0.495
02493	0.3729	0.4131	0.3940	0.496
06992	0.3843	0.4303	0.4045	0.496
99535	0.4001	0.4439	0.4205	0.497
13310	0.4127	0.4562	0.4344	0.490
13773	0.4205	0.4705	0.4455	0.493
18176	0.4353	0.4818	0.4587	0.495
21050	0.4511	0.4944	0.4747	0.495
24273	0.4644	0.5028	0.4861	0.495
28801	0.4781	0.5238	0.5010	0.493
28552	0.4939	0.5412	0.5175	0.490
30677	0.5066	0.5566	0.5321	0.487
34102	0.5223	0.5723	0.5469	0.495
37520	0.5379	0.5878	0.5579	0.491
37041	0.5444	0.5983	0.5746	0.497
39190	0.5649	0.6133	0.5901	0.495
44573	0.5812	0.6312	0.6062	0.499
47521	0.5964	0.6443	0.6204	0.497
50559	0.6130	0.6532	0.6351	0.495
52793	0.6249	0.6702	0.6478	0.497
56864	0.6365	0.6864	0.6615	0.495
59383	0.6503	0.7034	0.6708	0.499
63176	0.6579	0.7144	0.6841	0.497
67005	0.6705	0.7304	0.7005	0.495
71138	0.6862	0.7444	0.7138	0.497
75162	0.7019	0.7496	0.7257	0.493
83196	0.7098	0.7534	0.7376	0.496
86569	0.7141	0.7819	0.7483	0.499
91115	0.7315	0.7941	0.7628	0.496
99881	0.7444	0.7998	0.7736	0.497
59813	0.7535	0.8160	0.7847	0.494
60532	0.7539	0.8323	0.7961	0.496
61261	0.7728	0.8413	0.8086	0.494
65336	0.7913	0.8488	0.8201	0.494
67157	0.8077	0.8642	0.8319	0.495
69472	0.8144	0.8829	0.8435	0.491
66013	0.8328	0.8912	0.8620	0.495
90900	0.8408	0.9090	0.8749	0.497
67531	0.8493	0.9261	0.8878	0.488
66601	0.8563	0.9385	0.9024	0.496
67751	0.8823	0.9492	0.9137	0.496
70845	0.8989	0.9643	0.9346	0.494
71915	0.9150	0.9847	0.9598	0.496
74465	0.9183	1.0219	0.9601	0.496
77222	0.9297	1.0394	0.9746	0.491
80851	0.9488	1.0743	0.9906	0.493
29102	0.2944	0.3171	0.3058	0.333
60047	0.3037	0.2316	0.3187	0.273
73408	0.3153	0.2468	0.3187	0.499
85014	0.3261	0.3619	0.3440	0.494
90623	0.3444	0.3749	0.3582	0.497
91530	0.4404	0.3905	0.3700	0.495
96870	0.4644	0.3994	0.3849	0.495
02494	0.3729	0.4131	0.3940	0.496
06993	0.3843	0.4303	0.4045	0.496
99536	0.4001	0.4439	0.4205	0.497
13311	0.4127	0.4562	0.4344	0.490
13774	0.4205	0.4705	0.4455	0.493
18177	0.4353	0.4818	0.4587	0.495
21051	0.4511	0.4944	0.4747	0.495
24274	0.4644	0.5028	0.4861	0.495
28802	0.4781	0.5238	0.5010	0.493
28553	0.4939	0.5412	0.5175	0.490

TABLE 5-38. CRACK GROWTH DATA SPECIMEN GT160KAB49-31 S/N 1

CYCLE #	CLACK LENGTH (INS)		MAX. STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
3111	0.3426	0.3105	3493.	- 187
3109	0.3534	0.3335	6905	- 300
3108	0.3648	0.3414	47644	- 312
3107	0.3684	0.3451	6855.	- 319
3106	0.3708	0.3371	6905	- 302
3105	0.3718	0.3395	6922.	- 299
3104	0.3730	0.3449	6939.	- 305
3103	0.3733	0.3459	6905.	- 307
3102	0.3737	0.3469	6905.	- 304
3101	0.3738	0.3471	6889.	- 308
3100	0.3739	0.3471	6905.	- 302
3099	0.3739	0.3471	6939.	- 309
3098	0.3739	0.3471	6905.	- 304
3097	0.3739	0.3471	6905.	- 306
3096	0.3739	0.3471	6905.	- 309
3095	0.3739	0.3471	6905.	- 312
3094	0.3739	0.3471	6905.	- 314
3093	0.3739	0.3471	6905.	- 317
3092	0.3739	0.3471	6905.	- 320
3091	0.3739	0.3471	6905.	- 323
3090	0.3739	0.3471	6905.	- 326
3089	0.3739	0.3471	6905.	- 329
3088	0.3739	0.3471	6905.	- 332
3087	0.3739	0.3471	6905.	- 335
3086	0.3739	0.3471	6905.	- 338
3085	0.3739	0.3471	6905.	- 341
3084	0.3739	0.3471	6905.	- 344
3083	0.3739	0.3471	6905.	- 347
3082	0.3739	0.3471	6905.	- 350
3081	0.3739	0.3471	6905.	- 353
3080	0.3739	0.3471	6905.	- 356
3079	0.3739	0.3471	6905.	- 359
3078	0.3739	0.3471	6905.	- 362
3077	0.3739	0.3471	6905.	- 365
3076	0.3739	0.3471	6905.	- 368
3075	0.3739	0.3471	6905.	- 371
3074	0.3739	0.3471	6905.	- 374
3073	0.3739	0.3471	6905.	- 377
3072	0.3739	0.3471	6905.	- 380
3071	0.3739	0.3471	6905.	- 383
3070	0.3739	0.3471	6905.	- 386
3069	0.3739	0.3471	6905.	- 389
3068	0.3739	0.3471	6905.	- 392
3067	0.3739	0.3471	6905.	- 395
3066	0.3739	0.3471	6905.	- 398
3065	0.3739	0.3471	6905.	- 401
3064	0.3739	0.3471	6905.	- 404
3063	0.3739	0.3471	6905.	- 407
3062	0.3739	0.3471	6905.	- 410
3061	0.3739	0.3471	6905.	- 413
3060	0.3739	0.3471	6905.	- 416
3059	0.3739	0.3471	6905.	- 419
3058	0.3739	0.3471	6905.	- 422
3057	0.3739	0.3471	6905.	- 425
3056	0.3739	0.3471	6905.	- 428
3055	0.3739	0.3471	6905.	- 431
3054	0.3739	0.3471	6905.	- 434
3053	0.3739	0.3471	6905.	- 437
3052	0.3739	0.3471	6905.	- 440
3051	0.3739	0.3471	6905.	- 443
3050	0.3739	0.3471	6905.	- 446
3049	0.3739	0.3471	6905.	- 449
3048	0.3739	0.3471	6905.	- 452
3047	0.3739	0.3471	6905.	- 455
3046	0.3739	0.3471	6905.	- 458
3045	0.3739	0.3471	6905.	- 461
3044	0.3739	0.3471	6905.	- 464
3043	0.3739	0.3471	6905.	- 467
3042	0.3739	0.3471	6905.	- 470
3041	0.3739	0.3471	6905.	- 473
3040	0.3739	0.3471	6905.	- 476
3039	0.3739	0.3471	6905.	- 479
3038	0.3739	0.3471	6905.	- 482
3037	0.3739	0.3471	6905.	- 485

TABLE 5-40. CRACK GROWTH DATA SPECIMEN GT160KA849-31 S/N 3

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INCHES	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
5882	0.2673	0.2918	6869	-99
5899	0.3099	0.3018	7005	-98
5902	0.3130	0.3109	6972	-500
5916	0.3216	0.3216	6959	-99
5938	0.3250	0.3314	7005	-500
5954	0.3378	0.3378	7005	-98
5966	0.3497	0.3379	7005	-98
5983	0.3627	0.3356	7021	-99
5993	0.3761	0.3664	6989	-99
6004	0.3884	0.3679	6989	-99
6017	0.4220	0.3783	7022	-99
6030	0.4551	0.4026	6972	-500
6048	0.4778	0.4013	7005	-98
6066	0.4908	0.4249	6989	-98
6082	0.5130	0.4201	7005	-500
6099	0.5464	0.4319	7005	-98
6116	0.5697	0.4624	7005	-500
6133	0.5941	0.4752	6989	-501
6150	0.6166	0.4823	7005	-500
6167	0.6395	0.4977	6989	-99
6184	0.6630	0.5104	6959	-501
6201	0.6872	0.5229	6972	-502
6218	0.7119	0.5369	7005	-95
6235	0.7367	0.5517	6989	-96
6252	0.7614	0.5674	6989	-99
6269	0.7861	0.5832	6972	-501
6286	0.8108	0.6091	7005	-98
6303	0.8355	0.6359	6989	-504
6320	0.8602	0.6626	6989	-501
6337	0.8849	0.6893	6989	-99
6354	0.9096	0.7160	6972	-500
6371	0.9343	0.7427	6972	-98
6388	0.9590	0.7694	6972	-95
6405	0.9837	0.7961	6972	-98
6422	1.0084	0.8228	6972	-98
6439	1.0331	0.8495	6972	-98
6456	1.0578	0.8762	6972	-98
6473	1.0825	0.9029	6972	-98
6490	1.1072	0.9296	6972	-98
6507	1.1319	0.9563	6972	-98
6524	1.1566	0.9830	6972	-98
6541	1.1813	1.0097	6972	-98
6558	1.2060	1.0364	6972	-98
6575	1.2307	1.0631	6972	-98
6592	1.2554	1.0898	6972	-98
6609	1.2801	1.1165	6972	-98
6626	1.3048	1.1432	6972	-98
6643	1.3295	1.1699	6972	-98
6660	1.3542	1.1966	6972	-98
6677	1.3789	1.2233	6972	-98
6694	1.4036	1.2500	6972	-98
6711	1.4283	1.2767	6972	-98
6728	1.4530	1.3034	6972	-98
6745	1.4777	1.3301	6972	-98
6762	1.5024	1.3568	6972	-98
6779	1.5271	1.3835	6972	-98
6796	1.5518	1.4102	6972	-98
6813	1.5765	1.4369	6972	-98
6830	1.6012	1.4636	6972	-98
6847	1.6259	1.4903	6972	-98
6864	1.6506	1.5170	6972	-98
6881	1.6753	1.5437	6972	-98
6898	1.7000	1.5704	6972	-98
6915	1.7247	1.5971	6972	-98
6932	1.7494	1.6238	6972	-98
6949	1.7741	1.6505	6972	-98
6966	1.7988	1.6772	6972	-98
6983	1.8235	1.7039	6972	-98
7000	1.8482	1.7306	6972	-98
7017	1.8729	1.7573	6972	-98
7034	1.8976	1.7840	6972	-98
7051	1.9223	1.8107	6972	-98
7068	1.9470	1.8374	6972	-98
7085	1.9717	1.8641	6972	-98
7102	1.9964	1.8908	6972	-98
7119	2.0211	1.9175	6972	-98
7136	2.0458	1.9442		

TABLE 5-41. CRACK GROWTH DATA SPECIMEN GT160KAB49-31 S/N 4

CYCLE NO.	CRACK LENGTH (INS)			MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT	AVERAGE		
102	0.2981	0.2113	0.2567	11559	-497
210	0.3103	0.2207	0.2665	11693	-501
320	0.3225	0.2329	0.2777	11810	-490
430	0.3347	0.2451	0.2899	11927	-492
540	0.3469	0.2573	0.3021	12044	-493
650	0.3591	0.2695	0.3143	12161	-490
760	0.3713	0.2817	0.3265	12278	-493
870	0.3835	0.2939	0.3387	12395	-492
980	0.3957	0.3061	0.3509	12512	-491
1090	0.4079	0.3183	0.3631	12629	-492
1200	0.4201	0.3305	0.3753	12746	-490
1310	0.4323	0.3427	0.3875	12863	-491
1420	0.4445	0.3549	0.3997	12980	-492
1530	0.4567	0.3671	0.4119	13097	-490
1640	0.4689	0.3793	0.4241	13214	-491
1750	0.4811	0.3915	0.4363	13331	-492
1860	0.4933	0.4037	0.4485	13448	-490
1970	0.5055	0.4159	0.4607	13565	-491
2080	0.5177	0.4281	0.4729	13682	-492
2190	0.5299	0.4403	0.4851	13799	-490
2300	0.5421	0.4525	0.4973	13916	-491
2410	0.5543	0.4647	0.5095	14033	-492
2520	0.5665	0.4769	0.5217	14150	-490
2630	0.5787	0.4891	0.5339	14267	-491
2740	0.5909	0.5013	0.5461	14384	-492
2850	0.6031	0.5135	0.5583	14501	-490
2960	0.6153	0.5257	0.5705	14618	-491
3070	0.6275	0.5379	0.5827	14735	-492
3180	0.6397	0.5501	0.5949	14852	-490
3290	0.6519	0.5623	0.6071	14969	-491
3400	0.6641	0.5745	0.6193	15086	-492
3510	0.6763	0.5867	0.6315	15203	-490
3620	0.6885	0.5989	0.6437	15320	-491
3730	0.7007	0.6111	0.6559	15437	-492
3840	0.7129	0.6233	0.6681	15554	-490
3950	0.7251	0.6355	0.6803	15671	-491
4060	0.7373	0.6477	0.6925	15788	-492
4170	0.7495	0.6599	0.7047	15905	-490
4280	0.7617	0.6721	0.7169	16022	-491
4390	0.7739	0.6843	0.7291	16139	-492
4500	0.7861	0.6965	0.7413	16256	-490
4610	0.7983	0.7087	0.7535	16373	-491
4720	0.8105	0.7209	0.7657	16490	-492
4830	0.8227	0.7331	0.7779	16607	-490
4940	0.8349	0.7453	0.7901	16724	-491
5050	0.8471	0.7575	0.8023	16841	-492
5160	0.8593	0.7697	0.8145	16958	-490
5270	0.8715	0.7819	0.8267	17075	-491
5380	0.8837	0.7941	0.8389	17192	-492
5490	0.8959	0.8063	0.8511	17309	-490
5600	0.9081	0.8185	0.8633	17426	-491
5710	0.9203	0.8307	0.8755	17543	-492
5820	0.9325	0.8429	0.8877	17660	-490
5930	0.9447	0.8551	0.8999	17777	-491
6040	0.9569	0.8673	0.9121	17894	-492
6150	0.9691	0.8795	0.9243	18011	-490
6260	0.9813	0.8917	0.9365	18128	-491
6370	0.9935	0.9039	0.9487	18245	-492
6480	1.0057	0.9161	0.9609	18362	-490
6590	1.0179	0.9283	0.9731	18479	-491
6700	1.0301	0.9405	0.9853	18596	-492
6810	1.0423	0.9527	0.9975	18713	-490
6920	1.0545	0.9649	1.0097	18830	-491
7030	1.0667	0.9771	1.0219	18947	-492
7140	1.0789	0.9893	1.0341	19064	-490
7250	1.0911	1.0015	1.0463	19181	-491
7360	1.1033	1.0137	1.0585	19298	-492
7470	1.1155	1.0259	1.0707	19415	-490
7580	1.1277	1.0381	1.0829	19532	-491
7690	1.1399	1.0503	1.0951	19649	-492
7800	1.1521	1.0625	1.1073	19766	-490
7910	1.1643	1.0747	1.1195	19883	-491
8020	1.1765	1.0869	1.1317	19999	-492
8130	1.1887	1.0991	1.1439	20116	-490
8240	1.2009	1.1113	1.1561	20233	-491
8350	1.2131	1.1235	1.1683	20350	-492
8460	1.2253	1.1357	1.1805	20467	-490
8570	1.2375	1.1479	1.1927	20584	-491
8680	1.2497	1.1601	1.2049	20701	-492
8790	1.2619	1.1723	1.2171	20818	-490
8900	1.2741	1.1845	1.2293	20935	-491
9010	1.2863	1.1967	1.2415	21052	-492
9120	1.2985	1.2089	1.2537	21169	-490
9230	1.3107	1.2211	1.2659	21286	-491
9340	1.3229	1.2333	1.2781	21403	-492
9450	1.3351	1.2455	1.2903	21520	-490
9560	1.3473	1.2577	1.3025	21637	-491
9670	1.3595	1.2699	1.3147	21754	-492
9780	1.3717	1.2821	1.3269	21871	-490
9890	1.3839	1.2943	1.3391	21988	-491
10000	1.3961	1.3065	1.3513	22105	-492

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 permit fully legible reproduction

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 permit fully legible reproduction

TABLE 5-42. CRACK GROWTH DATA SPECIMEN GT160KAB49-13 S/N 1

CYCLE #	CRACK LENGTH (INS)			MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT	AVERAGE		
2	0.3690	0.3800	0.3745	-483	0.350
3	0.3753	0.4020	0.3891	-462	0.350
4	0.3870	0.4146	0.4008	-467	0.350
112500	0.4026	0.4195	0.4115	-462	0.350
146226	0.4276	0.4273	0.4275	-457	0.350
174783	0.4491	0.4391	0.4441	-442	0.350
202405	0.4725	0.4537	0.4631	-442	0.350
215406	0.4940	0.4635	0.4787	-442	0.350
227760	0.5052	0.4743	0.4902	-442	0.350
237922	0.5082	0.4822	0.5022	-467	0.350
242911	0.5129	0.5143	0.5220	-456	0.350
250340	0.5307	0.5319	0.5313	-451	0.350
256076	0.5369	0.5334	0.5386	-456	0.350
258444	0.5363	0.5249	0.5306	-450	0.350
260967	0.5351	0.5049	0.5250	-453	0.350
266125	0.5342	0.5191	0.5016	-443	0.350
273127	0.6033	0.6076	0.611	-433	0.350
278303	0.6229	0.6037	0.6134	-433	0.350
284446	0.6238	0.6067	0.6152	-433	0.350
285726	0.6233	0.6043	0.6138	-433	0.350
296671	0.6253	0.6110	0.6182	-433	0.350
301013	0.6278	0.6109	0.6193	-433	0.350
304635	0.6263	0.6189	0.6226	-433	0.350
304355	0.6253	0.6189	0.6226	-433	0.350
307356	0.6273	0.6206	0.6239	-433	0.350
312256	0.6265	0.6202	0.6260	-433	0.350
315405	0.6233	0.6190	0.6211	-433	0.350
316391	0.6243	0.6353	0.6298	-433	0.350
320307	0.6238	0.6336	0.6287	-433	0.350
320388	0.6230	0.6361	0.6295	-433	0.350
321999	0.6214	0.6373	0.6293	-433	0.350
324336	0.6209	0.6395	0.6302	-433	0.350
326444	0.6209	0.6269	0.6234	-433	0.350
328440	0.6214	0.6317	0.6265	-433	0.350
330325	0.6243	0.6479	0.6361	-433	0.350
332366	0.6229	0.6530	0.6379	-433	0.350
335632	1.0140	0.6330	0.8235	-433	0.350
336649	1.0230	0.9236	0.9733	-433	0.350
340102	1.0349	0.9363	0.9856	-433	0.350
341179	1.0607	0.9608	1.0107	-433	0.350
341667	1.0721	0.9822	1.0271	-433	0.350
342195	1.0935	1.0023	1.0479	-433	0.350
342752	1.1112	1.0223	1.0670	-433	0.350
342911	1.1122	1.0426	1.0774	-433	0.350

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TABLE 5-43. CRACK GROWTH DATA SPECIMEN GT160KA949-13 S/N 2

CYCLE #	CRACK LENGTH (INS)		MAX STRESS(MSI)	STRESS RATIO	S3614	0.762	0.7079	0.7521	10585.	0.050
	LEFT	RIGHT								
495.	0.3104	0.3212	0.3159	0.050	33614	0.762	0.7079	0.7521	10585.	0.050
980.	0.3239	0.3236	0.3238	0.050	33639	0.763	0.7193	0.7584	10585.	0.050
1965.	0.3365	0.3261	0.3313	0.050	33662	0.8068	0.8068	0.7637	10585.	0.050
4658.	0.3492	0.3303	0.3397	0.050	33713	0.8161	0.7232	0.7697	10585.	0.050
5443.	0.3618	0.3623	0.3621	0.050	33857	0.8255	0.8255	0.7772	10585.	0.050
7410.	0.3744	0.3537	0.3641	0.050	34035	0.8325	0.7381	0.7853	10596.	0.050
8059.	0.3865	0.3651	0.3758	0.050	34117	0.8330	0.7477	0.7903	10585.	0.050
11536.	0.3985	0.3823	0.3904	0.050	34335	0.8321	0.7700	0.8012	10585.	0.050
12193.	0.4027	0.3994	0.4010	0.050	34360	0.8325	0.7862	0.8094	10585.	0.050
12931.	0.4154	0.4099	0.4127	0.050	34290	0.8334	0.7954	0.8144	10585.	0.050
13478.	0.4290	0.4255	0.4273	0.050	34429	0.8422	0.8029	0.8228	10585.	0.050
14713.	0.4406	0.4287	0.4347	0.050	34422	0.8467	0.8125	0.8296	10585.	0.050
15930.	0.4533	0.4303	0.4418	0.050	34365	0.8507	0.8217	0.8362	10585.	0.050
16921.	0.4653	0.4450	0.4554	0.050	34681	0.8546	0.8309	0.8427	10585.	0.050
16556.	0.4792	0.4588	0.4690	0.050	35006	0.8613	0.8400	0.8507	10585.	0.050
17091.	0.4918	0.4661	0.4790	0.050	35153	0.8622	0.8501	0.8561	10585.	0.050
17594.	0.5044	0.4783	0.4914	0.050	35822	0.8715	0.8519	0.8617	10596.	0.050
18624.	0.5127	0.4854	0.5131	0.050	35918	0.8741	0.8610	0.8696	10574.	0.050
19624.	0.5213	0.5125	0.5169	0.050	36040	0.8825	0.8711	0.8768	10585.	0.050
20356.	0.5333	0.5272	0.5303	0.050	36154	0.8918	0.8724	0.8821	10585.	0.050
21213.	0.5424	0.5443	0.5433	0.050	36172	0.8918	0.8816	0.8867	10574.	0.050
21608.	0.5550	0.5492	0.5521	0.050	36298	0.9027	0.8908	0.8917	10585.	0.050
22732.	0.5643	0.5535	0.5589	0.050	36513	0.9025	0.8922	0.8999	10574.	0.050
23648.	0.5736	0.5574	0.5655	0.050	36674	0.9108	0.9065	0.9082	10574.	0.050
24944.	0.5780	0.5666	0.5723	0.050	36757	0.9162	0.9159	0.9159	10574.	0.050
25217.	0.5847	0.5758	0.5802	0.050	36788	0.9286	0.9192	0.9235	10574.	0.050
25797.	0.5913	0.5850	0.5881	0.050	36829	0.9378	0.9379	0.9379	10574.	0.050
26436.	0.6006	0.5920	0.5963	0.050	36943	0.9501	0.9271	0.9336	10585.	0.050
27287.	0.6099	0.5999	0.6049	0.050	36981	0.9498	0.9288	0.9393	10574.	0.050
28302.	0.6170	0.6091	0.6130	0.050	36999	0.9653	0.9298	0.9471	10574.	0.050
28836.	0.6201	0.6182	0.6192	0.050	37068	0.9708	0.9288	0.9517	10574.	0.050
29630.	0.6240	0.6274	0.6257	0.050	37090	0.9839	0.9293	0.9566	10574.	0.050
29803.	0.6333	0.6305	0.6319	0.050	37159	0.9836	0.9383	0.9621	10564.	0.050</

TABLE 5-44. CRACK GROWTH DATA SPECIMEN GT160KAB49-13 S/N 3

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TABLE 5-45. CRACK GROWTH DATA SPECIMEN GT160KAB49-13 S/N 4

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO	
	LEFT	RIGHT			
12983	0.3140	0.3144	0.3152	12545	58445
12990	0.3184	0.3184	0.3237	12534	0.7295
13000	0.3189	0.3189	0.3237	12534	0.7316
13010	0.3223	0.3223	0.3393	12534	0.7350
13020	0.3268	0.3268	0.3440	12534	0.7450
13030	0.3311	0.3311	0.3573	12534	0.7553
13040	0.3362	0.3362	0.3660	12534	0.7592
13050	0.3407	0.3407	0.3737	12534	0.7644
13060	0.3451	0.3451	0.3894	12534	0.7737
13070	0.3496	0.3496	0.4044	12534	0.7810
13080	0.3541	0.3541	0.4194	12534	0.7882
13090	0.3586	0.3586	0.4344	12534	0.7955
13100	0.3631	0.3631	0.4494	12534	0.8028
13110	0.3676	0.3676	0.4644	12534	0.8101
13120	0.3721	0.3721	0.4794	12534	0.8174
13130	0.3766	0.3766	0.4944	12534	0.8247
13140	0.3811	0.3811	0.5094	12534	0.8320
13150	0.3856	0.3856	0.5244	12534	0.8393
13160	0.3901	0.3901	0.5394	12534	0.8466
13170	0.3946	0.3946	0.5544	12534	0.8539
13180	0.3991	0.3991	0.5694	12534	0.8612
13190	0.4036	0.4036	0.5844	12534	0.8685
13200	0.4081	0.4081	0.5994	12534	0.8758
13210	0.4126	0.4126	0.6144	12534	0.8831
13220	0.4171	0.4171	0.6294	12534	0.8904
13230	0.4216	0.4216	0.6444	12534	0.9000
13240	0.4261	0.4261	0.6594	12534	0.9096
13250	0.4306	0.4306	0.6744	12534	0.9192
13260	0.4351	0.4351	0.6894	12534	0.9288
13270	0.4396	0.4396	0.7044	12534	0.9384
13280	0.4441	0.4441	0.7194	12534	0.9480
13290	0.4486	0.4486	0.7344	12534	0.9576
13300	0.4531	0.4531	0.7494	12534	0.9672
13310	0.4576	0.4576	0.7644	12534	0.9768
13320	0.4621	0.4621	0.7794	12534	0.9864
13330	0.4666	0.4666	0.7944	12534	0.9960
13340	0.4711	0.4711	0.8094	12534	1.0056
13350	0.4756	0.4756	0.8244	12534	1.0152
13360	0.4801	0.4801	0.8394	12534	1.0248
13370	0.4846	0.4846	0.8544	12534	1.0344
13380	0.4891	0.4891	0.8694	12534	1.0440
13390	0.4936	0.4936	0.8844	12534	1.0536
13400	0.4981	0.4981	0.8994	12534	1.0632
13410	0.5026	0.5026	0.9144	12534	1.0728
13420	0.5071	0.5071	0.9294	12534	1.0824
13430	0.5116	0.5116	0.9444	12534	1.0920
13440	0.5161	0.5161	0.9594	12534	1.1016
13450	0.5206	0.5206	0.9744	12534	1.1112
13460	0.5251	0.5251	0.9894	12534	1.1208
13470	0.5296	0.5296	1.0044	12534	1.1304
13480	0.5341	0.5341	1.0194	12534	1.1400
13490	0.5386	0.5386	1.0344	12534	1.1496
13500	0.5431	0.5431	1.0494	12534	1.1592
13510	0.5476	0.5476	1.0644	12534	1.1688
13520	0.5521	0.5521	1.0794	12534	1.1784
13530	0.5566	0.5566	1.0944	12534	1.1880
13540	0.5611	0.5611	1.1094	12534	1.1976
13550	0.5656	0.5656	1.1244	12534	1

TABLE 5-46. CRACK GROWTH DATA SPECIMEN GT160KAB49-33 S/N 1

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
5510.	0.3798	0.3609	7062.	-0.300
9702.	0.3980	0.3732	7051.	-0.300
13940.	0.4158	0.3893	7062.	-0.300
17519.	0.4344	0.3969	7051.	-0.300
20130.	0.4488	0.4147	7051.	-0.300
22416.	0.4615	0.4300	7041.	-0.300
24827.	0.4793	0.4410	7051.	-0.300
28600.	0.4870	0.4592	7050.	-0.300
28954.	0.5031	0.4719	7041.	-0.300
31270.	0.5183	0.4871	7041.	-0.300
32822.	0.5302	0.5003	7041.	-0.300
34158.	0.5437	0.5155	7051.	-0.300
36153.	0.5615	0.5236	7041.	-0.300
37890.	0.5763	0.5380	7051.	-0.300
39254.	0.5886	0.5515	7051.	-0.300
41224.	0.6047	0.5647	7041.	-0.300
42864.	0.6195	0.5812	7030.	-0.300
44535.	0.6348	0.5977	7041.	-0.300
46156.	0.6534	0.6117	7041.	-0.300
47751.	0.6712	0.6197	7041.	-0.300
49294.	0.6865	0.6367	7051.	-0.300
51048.	0.7038	0.6494	7041.	-0.300
51999.	0.7170	0.6604	7041.	-0.300
52954.	0.7276	0.6782	7030.	-0.300
54150.	0.7458	0.6926	7041.	-0.300
55102.	0.7606	0.7057	7030.	-0.300
56457.	0.7784	0.7168	7030.	-0.300
57622.	0.7970	0.7290	7030.	-0.300
59482.	0.8144	0.7447	7030.	-0.300
60140.	0.8246	0.7625	7019.	-0.300
60952.	0.8377	0.7735	7009.	-0.300
61495.	0.8535	0.7820	7030.	-0.300
62468.	0.8733	0.7964	7030.	-0.300
63431.	0.8885	0.8108	7019.	-0.300
64401.	0.9042	0.8239	6998.	-0.300
65224.	0.9220	0.8366	7019.	-0.300
65826.	0.9398	0.8464	6998.	-0.300
66277.	0.9525	0.8591	7009.	-0.300
66914.	0.9733	0.8705	6998.	-0.300
67430.	0.9881	0.8773	6998.	-0.300
67997.	1.0046	0.8921	6987.	-0.300
68608.	1.0224	0.9027	6998.	-0.300
69030.	1.0402	0.9082	6987.	-0.300
69422.	1.0533	0.9260	6998.	-0.300
69872.	1.0694	0.9375	6987.	-0.300
70316.	1.0851	0.9519	6977.	-0.300
70579.	1.1029	0.9582	6977.	-0.300
70951.	1.1207	0.9676	6977.	-0.300
71225.	1.1385	0.9726	6966.	-0.300
71502.	1.1516	0.9866	6966.	-0.300

TABLE 5-47. CRACK GROWTH DATA SPECIMEN GT160XAB49-33 S/N 2

CRACK LENGTH INCH	CRACK LENGTH MILLI	AVERAGE	MAX. STRESS (PSI)	STRESS RATIO	STRESS RATIO
0.000	0.000	0.000	0	0	0
0.001	0.001	0.001	0	0	0
0.002	0.002	0.002	0	0	0
0.003	0.003	0.003	0	0	0
0.004	0.004	0.004	0	0	0
0.005	0.005	0.005	0	0	0
0.006	0.006	0.006	0	0	0
0.007	0.007	0.007	0	0	0
0.008	0.008	0.008	0	0	0
0.009	0.009	0.009	0	0	0
0.010	0.010	0.010	0	0	0
0.011	0.011	0.011	0	0	0
0.012	0.012	0.012	0	0	0
0.013	0.013	0.013	0	0	0
0.014	0.014	0.014	0	0	0
0.015	0.015	0.015	0	0	0
0.016	0.016	0.016	0	0	0
0.017	0.017	0.017	0	0	0
0.018	0.018	0.018	0	0	0
0.019	0.019	0.019	0	0	0
0.020	0.020	0.020	0	0	0
0.021	0.021	0.021	0	0	0
0.022	0.022	0.022	0	0	0
0.023	0.023	0.023	0	0	0
0.024	0.024	0.024	0	0	0
0.025	0.025	0.025	0	0	0
0.026	0.026	0.026	0	0	0
0.027	0.027	0.027	0	0	0
0.028	0.028	0.028	0	0	0
0.029	0.029	0.029	0	0	0
0.030	0.030	0.030	0	0	0
0.031	0.031	0.031	0	0	0
0.032	0.032	0.032	0	0	0
0.033	0.033	0.033	0	0	0
0.034	0.034	0.034	0	0	0
0.035	0.035	0.035	0	0	0
0.036	0.036	0.036	0	0	0
0.037	0.037	0.037	0	0	0
0.038	0.038	0.038	0	0	0
0.039	0.039	0.039	0	0	0
0.040	0.040	0.040	0	0	0
0.041	0.041	0.041	0	0	0
0.042	0.042	0.042	0	0	0
0.043	0.043	0.043	0	0	0
0.044	0.044	0.044	0	0	0
0.045	0.045	0.045	0	0	0
0.046	0.046	0.046	0	0	0
0.047	0.047	0.047	0	0	0
0.048	0.048	0.048	0	0	0
0.049	0.049	0.049	0	0	0
0.050	0.050	0.050	0	0	0
0.051	0.051	0.051	0	0	0
0.052	0.052	0.052	0	0	0
0.053	0.053	0.053	0	0	0
0.054	0.054	0.054	0	0	0
0.055	0.055	0.055	0	0	0
0.056	0.056	0.056	0	0	0
0.057	0.057	0.057	0	0	0
0.058	0.058	0.058	0	0	0
0.059	0.059	0.059	0	0	0
0.060	0.060	0.060	0	0	0
0.061	0.061	0.061	0	0	0
0.062	0.062	0.062	0	0	0
0.063	0.063	0.063	0	0	0
0.064	0.064	0.064	0	0	0
0.065	0.065	0.065	0	0	0
0.066	0.066	0.066	0	0	0
0.067	0.067	0.067	0	0	0
0.068	0.068	0.068	0	0	0
0.069	0.069	0.069	0	0	0
0.070	0.070	0.070	0	0	0
0.071	0.071	0.071	0	0	0
0.072	0.072	0.072	0	0	0
0.073	0.073	0.073	0	0	0
0.074	0.074	0.074	0	0	0
0.075	0.075	0.075	0	0	0
0.076	0.076	0.076	0	0	0
0.077	0.077	0.077	0	0	0
0.078	0.078	0.078	0	0	0
0.079	0.079	0.079	0	0	0
0.080	0.080	0.080	0	0	0
0.081	0.081	0.081	0	0	0
0.082	0.082	0.082	0	0	0
0.083	0.083	0.083	0	0	0
0.084	0.084	0.084	0	0	0
0.085	0.085	0.085	0	0	0
0.086	0.086	0.086	0	0	0
0.087	0.087	0.087	0	0	0
0.088	0.088	0.088	0	0	0
0.089	0.089	0.089	0	0	0
0.090	0.090	0.090	0	0	0
0.091	0.091	0.091	0	0	0
0.092	0.092	0.092	0	0	0
0.093	0.093	0.093	0	0	0
0.094	0.094	0.094	0	0	0
0.095	0.095	0.095	0	0	0
0.096	0.096	0.096	0	0	0
0.097	0.097	0.097	0	0	0
0.098	0.098	0.098	0	0	0
0.099	0.099	0.099	0	0	0
0.100	0.100	0.100	0	0	0

TABLE 5-48. CRACK GROWTH DATA SPECIMEN GT160KAB49-33 S/N 3

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT AVERAGE		
3-07.	0.2564	0.2687	7051.	- .500
8847.	0.2792	0.2849	7041.	- .500
13633.	0.2965	0.3050	7031.	- .500
18394.	0.3193	0.3207	7062.	- .500
23131.	0.3377	0.3413	7031.	- .500
25851.	0.3540	0.3565	7031.	- .500
29462.	0.3746	0.3760	7062.	- .500
33104.	0.3909	0.3923	7031.	- .500
36319.	0.4120	0.4118	7031.	- .500
39868.	0.4250	0.4331	7062.	- .500
42557.	0.4446	0.4492	7062.	- .500
44944.	0.4635	0.4699	7062.	- .500
47101.	0.4863	0.4877	7073.	- .500
50140.	0.5037	0.5078	7073.	- .500
52447.	0.5237	0.5246	7073.	- .500
54568.	0.5405	0.5432	7073.	- .500
56461.	0.5622	0.5604	7073.	- .500
58302.	0.5785	0.5788	7083.	- .500
60162.	0.5948	0.5978	7073.	- .500
61980.	0.6175	0.6132	7073.	- .500
63970.	0.6333	0.6360	7073.	- .500
65453.	0.6544	0.6538	7062.	- .500
67313.	0.6674	0.6786	7073.	- .500
68607.	0.6842	0.6934	7062.	- .500
70253.	0.7054	0.7166	7073.	- .500
71220.	0.7282	0.7285	7073.	- .500
72619.	0.7482	0.7507	7073.	- .500
73826.	0.7688	0.7681	7073.	- .500
74910.	0.7845	0.7909	7073.	- .500
76082.	0.8073	0.8088	7073.	- .500
76931.	0.8214	0.8321	7094.	- .500
77939.	0.8442	0.8467	7073.	- .500
78667.	0.8615	0.8679	7031.	- .500
79469.	0.8827	0.8831	7062.	- .500
80404.	0.8963	0.9004	7062.	- .500

TABLE 5-49. CRACK GROWTH DATA SPECIMEN GT160KAB49-33 S/N 4

CYCLE #	CRACK LENGTH (INS)		VA STRESS (PSI)	STRESS RATIO	VA STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT				
1395	0.3159	0.2948	0.3053	11385	25365	0.9170
1396	0.3211	0.3022	0.3137	11385	25359	0.9338
1397	0.3331	0.3098	0.3327	11385	25953	0.9506
1398	0.3467	0.3114	0.3310	11385	26114	0.9633
1399	0.3571	0.3220	0.3395	11385	26276	0.9819
1400	0.3682	0.3348	0.3303	11385	2637	1.0019
1401	0.3730	0.3404	0.3397	11385	2637	1.0223
1402	0.3823	0.3513	0.3669	11385	2637	1.0285
1403	0.3942	0.3636	0.3749	11385	2637	1.0617
1404	0.4014	0.3760	0.3900	11385	2637	1.0595
1405	0.4131	0.3882	0.4006	11385	2637	1.0837
1406	0.4212	0.3983	0.4110	11385	2637	1.1149
1407	0.4219	0.4128	0.4223	11385	2637	1.1149
1408	0.4223	0.4253	0.4333	11385	2637	1.1149
1409	0.4223	0.4253	0.4333	11385	2637	1.1149
1410	0.4223	0.4253	0.4333	11385	2637	1.1149
1411	0.4223	0.4253	0.4333	11385	2637	1.1149
1412	0.4223	0.4253	0.4333	11385	2637	1.1149
1413	0.4223	0.4253	0.4333	11385	2637	1.1149
1414	0.4223	0.4253	0.4333	11385	2637	1.1149
1415	0.4223	0.4253	0.4333	11385	2637	1.1149
1416	0.4223	0.4253	0.4333	11385	2637	1.1149
1417	0.4223	0.4253	0.4333	11385	2637	1.1149
1418	0.4223	0.4253	0.4333	11385	2637	1.1149
1419	0.4223	0.4253	0.4333	11385	2637	1.1149
1420	0.4223	0.4253	0.4333	11385	2637	1.1149
1421	0.4223	0.4253	0.4333	11385	2637	1.1149
1422	0.4223	0.4253	0.4333	11385	2637	1.1149
1423	0.4223	0.4253	0.4333	11385	2637	1.1149
1424	0.4223	0.4253	0.4333	11385	2637	1.1149
1425	0.4223	0.4253	0.4333	11385	2637	1.1149
1426	0.4223	0.4253	0.4333	11385	2637	1.1149
1427	0.4223	0.4253	0.4333	11385	2637	1.1149
1428	0.4223	0.4253	0.4333	11385	2637	1.1149
1429	0.4223	0.4253	0.4333	11385	2637	1.1149
1430	0.4223	0.4253	0.4333	11385	2637	1.1149
1431	0.4223	0.4253	0.4333	11385	2637	1.1149
1432	0.4223	0.4253	0.4333	11385	2637	1.1149
1433	0.4223	0.4253	0.4333	11385	2637	1.1149
1434	0.4223	0.4253	0.4333	11385	2637	1.1149
1435	0.4223	0.4253	0.4333	11385	2637	1.1149
1436	0.4223	0.4253	0.4333	11385	2637	1.1149
1437	0.4223	0.4253	0.4333	11385	2637	1.1149
1438	0.4223	0.4253	0.4333	11385	2637	1.1149
1439	0.4223	0.4253	0.4333	11385	2637	1.1149
1440	0.4223	0.4253	0.4333	11385	2637	1.1149
1441	0.4223	0.4253	0.4333	11385	2637	1.1149
1442	0.4223	0.4253	0.4333	11385	2637	1.1149
1443	0.4223	0.4253	0.4333	11385	2637	1.1149
1444	0.4223	0.4253	0.4333	11385	2637	1.1149
1445	0.4223	0.4253	0.4333	11385	2637	1.1149
1446	0.4223	0.4253	0.4			

TABLE 5-50. CRACK GROWTH DATA SPECIMEN GT160KAB49-17 S/N 1

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT AVERAGE		
?	0.2450	0.2500	0.	0.050
12277	0.2531	0.2500	7136.	0.050
22818	0.2612	0.2500	7136.	0.050
36812	0.2686	0.2505	7124.	0.050
42514	0.2767	0.2510	7112.	0.050
50523	0.2852	0.2505	7112.	0.050
57242	0.2933	0.2510	7112.	0.050
52457	0.3014	0.2526	7100.	0.050
64880	0.3095	0.2547	7100.	0.050
70693	0.3184	0.2599	7112.	0.050
73390	0.3230	0.2713	7124.	0.050
75893	0.3311	0.2760	7148.	0.050
78781	0.3400	0.2832	7124.	0.050
81142	0.3481	0.2905	7136.	0.050
83718	0.3562	0.2978	7136.	0.050
85729	0.3647	0.3056	7124.	0.050
96910	0.3689	0.3170	7148.	0.357
88669	0.3770	0.3227	7124.	0.050
90617	0.3832	0.3336	7136.	0.050
92386	0.3913	0.3419	7136.	0.050
93215	0.3994	0.3492	7136.	0.050
95417	0.4052	0.3601	7136.	0.050
97162	0.4117	0.3674	7136.	0.050
98493	0.4199	0.3783	7136.	0.050
99856	0.4280	0.3876	7136.	0.050
100998	0.4359	0.3955	7124.	0.050
102187	0.4400	0.4068	7124.	0.050
103477	0.4481	0.4151	7136.	0.050
104780	0.4562	0.4240	7124.	0.050
106141	0.4643	0.4328	7112.	0.050
107396	0.4716	0.4437	7112.	0.050
108313	0.4797	0.4479	7124.	0.050
109304	0.4863	0.4593	7100.	0.050
110243	0.4944	0.4639	7124.	0.050
111193	0.4998	0.4749	7100.	0.050
112215	0.5079	0.4816	7100.	0.050
113156	0.5160	0.4878	7100.	0.050
113848	0.5199	0.4987	7100.	0.050
114537	0.5280	0.5050	7124.	0.050
115304	0.5349	0.5159	7124.	0.050
116366	0.5431	0.5232	7136.	0.050
117353	0.5512	0.5320	7112.	0.050
118169	0.5581	0.5429	7100.	0.050
119137	0.5666	0.5507	7076.	0.050
119999	0.5747	0.5600	7088.	0.050
120722	0.5828	0.5631	7088.	0.050
121586	0.5909	0.5704	7051.	0.050
122276	0.5983	0.5766	7063.	0.050
122908	0.6068	0.5863	7076.	0.050
123854	0.6149	0.5953	7031.	0.050
124624	0.6230	0.6047	7039.	0.050
125362	0.6318	0.6099	7039.	0.050
126034	0.6403	0.6192	7136.	0.050
126823	0.6485	0.6270	7136.	0.050
127397	0.6562	0.6379	7112.	0.050
127993	0.6643	0.6421	7100.	0.050
128606	0.6701	0.6530	7124.	0.050
129375	0.6774	0.6613	7112.	0.050
129789	0.6859	0.6670	7088.	0.050

TABLE 5-51. CRACK GROWTH DATA SPECIMEN GT160KAB49-17 S/N 2

CRACK LENGTH (INS)	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO	
	LEFT	RIGHT			
2.	0.2500	0.2700	10737	0.050	0.5285
3003.	0.2506	0.2801	11250.	0.050	0.5915
4538.	0.2500	0.2907	11290.	0.050	0.6046
6373.	0.2512	0.3009	11278.	0.050	0.6176
7413.	0.2512	0.3110	11266.	0.050	0.6307
8466.	0.2512	0.3211	11290.	0.050	0.6438
9485.	0.2525	0.3312	11290.	0.050	0.6568
10447.	0.2525	0.3414	11278.	0.050	0.6698
11301.	0.2537	0.3525	11290.	0.050	0.6828
12290.	0.2537	0.3631	11290.	0.050	0.6958
13048.	0.2537	0.3732	11326.	0.050	0.7088
13947.	0.2531	0.3833	11326.	0.050	0.7218
14973.	0.2537	0.3934	11326.	0.050	0.7348
15349.	0.2537	0.4036	11338.	0.050	0.7478
15877.	0.2530	0.4137	11338.	0.050	0.7608
16443.	0.2562	0.4238	11314.	0.050	0.7738
16935.	0.2568	0.4339	11316.	0.050	0.7868
17381.	0.2581	0.4441	11314.	0.050	0.7998
18136.	0.2575	0.4542	11314.	0.050	0.8128
18661.	0.2568	0.4643	11326.	0.050	0.8258
19221.	0.2612	0.4744	11314.	0.050	0.8388
19847.	0.2705	0.4845	11316.	0.050	0.8518
20321.	0.2755	0.4946	11302.	0.050	0.8648
20766.	0.2811	0.5048	11314.	0.050	0.8778
21297.	0.2866	0.5149	11362.	0.050	0.8908
21705.	0.2981	0.5260	11375.	0.050	0.9038
22132.	0.3047	0.5362	11375.	0.050	0.9168
22587.	0.3133	0.5463	11338.	0.050	0.9298
23049.	0.3166	0.5564	11362.	0.050	0.9428
23658.	0.3259	0.5665	11350.	0.050	0.9558
23844.	0.3296	0.5767	11362.	0.050	0.9688
24080.	0.3414	0.5829	11338.	0.050	0.9818
24710.	0.3543	0.5926	11362.	0.050	0.9948
24968.	0.3595	0.6027	11326.	0.050	1.0078
25318.	0.3663	0.6128	11338.	0.050	1.0208
25601.	0.3754	0.6210	11326.	0.050	1.0338
25979.	0.3837	0.6311	11338.	0.050	1.0468
26390.	0.3981	0.6403	11338.	0.050	1.0598
26921.	0.4093	0.6504	11338.	0.050	1.0728
27293.	0.4223	0.6536	11326.	0.050	1.0858
27615.	0.4258	0.6668	11326.	0.050	1.0988
27988.	0.4359	0.6774	11326.	0.050	1.1118
28418.	0.4509	0.6847	11326.	0.050	1.1248
28789.	0.4640	0.6933	11326.	0.050	1.1378
29166.	0.4758	0.7035	11338.	0.050	1.1508
29517.	0.4889	0.7121	11314.	0.050	1.1638
29828.	0.5019	0.7203	11314.	0.050	1.1768
301019.	0.5131	0.7305	11314.	0.050	1.1898
30378.	0.5262	0.7372	11314.	0.050	1.2028
30683.	0.5393	0.7435	11314.	0.050	1.2158
31088.	0.5523	0.7483	11314.	0.050	1.2288
31379.	0.5654	0.7590	11302.	0.050	1.2418

TABLE 5-52. CRACK GROWTH DATA SPECIMEN GT160KAB49-17 S/N 3

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
2.	0.2830	0.2850	7270.	0.500
54186.	0.3033	0.3032	7270.	0.500
90874.	0.3215	0.3213	7258.	0.500
122096.	0.3407	0.3405	7258.	0.500
151385.	0.3772	0.3766	7258.	0.500
180581.	0.3865	0.3858	7258.	0.500
208165.	0.3816	0.4068	7258.	0.500
236499.	0.3911	0.4250	7258.	0.500
264870.	0.3953	0.4466	7245.	0.500
293128.	0.4103	0.4552	7245.	0.500
321581.	0.4233	0.4734	7258.	0.500
350039.	0.4416	0.4820	7245.	0.500
378512.	0.4573	0.4993	7245.	0.500
406954.	0.4738	0.5105	7245.	0.500
435385.	0.4868	0.5226	7245.	0.500
463806.	0.5016	0.5407	7258.	0.500
492206.	0.5164	0.5515	7245.	0.500
520630.	0.5298	0.5673	7258.	0.500
549055.	0.5469	0.5796	7245.	0.500
577484.	0.5564	0.5978	7258.	0.500
605913.	0.5747	0.6081	7245.	0.500
634343.	0.5911	0.6238	7245.	0.500
662778.	0.6043	0.6358	7245.	0.500
691203.	0.6226	0.6496	7245.	0.500
719628.	0.6365	0.6660	7245.	0.500
748053.	0.6547	0.6798	7245.	0.500
776478.	0.6687	0.6954	7245.	0.500
804903.	0.6843	0.7092	7245.	0.500
833328.	0.7026	0.7222	7245.	0.500
861753.	0.7122	0.7403	7233.	0.500
890178.	0.7278	0.7576	7233.	0.500
918603.	0.7435	0.7732	7245.	0.500
947028.	0.7592	0.7904	7233.	0.500
975453.	0.7687	0.7939	7233.	0.500
1003878.	0.7879	0.8181	7270.	0.500
1032203.	0.8035	0.8310	7233.	0.500
1060528.	0.8166	0.8492	7221.	0.500
1088853.	0.8314	0.8656	7221.	0.500
1117178.	0.8488	0.8786	7233.	0.500
1145503.	0.8644	0.8967	7221.	0.500
1173828.	0.8792	0.9140	7221.	0.500
1202153.	0.8937	0.9304	7233.	0.500
1230478.	0.9140	0.9442	7221.	0.500
1258803.	0.9314	0.9589	7221.	0.500
1287128.	0.9419	0.9762	7196.	0.500
1315453.	0.9592	0.9909	7209.	0.500
1343778.	0.9732	1.0074	7196.	0.500
1372103.	0.9871	1.0159	7209.	0.500
1400428.	1.0054	1.0315	7196.	0.500
1428753.	1.0202	1.0484	7196.	0.500
1457078.	1.0375	1.0657	7196.	0.500

TABLE 5-53. CRACK GROWTH DATA SPECIMEN GT160KAB49-17 S/N 4

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT AVERAGE		
2.	0.2300	0.2250	11204.	0.500
5237.	0.2323	0.2409	11204.	0.500
15567.	0.2535	0.2731	11204.	0.500
10648.	0.2671	0.2864	11204.	0.500
21656.	0.2732	0.3024	11204.	0.500
23078.	0.2988	0.3076	11204.	0.500
25477.	0.3043	0.3205	11204.	0.500
27296.	0.3187	0.3334	11204.	0.500
29333.	0.3331	0.3478	11204.	0.500
31208.	0.3482	0.3599	11204.	0.500
33048.	0.3634	0.3713	11204.	0.500
33878.	0.3702	0.3789	11204.	0.500
40017.	0.4240	0.4327	11204.	0.500
41560.	0.4388	0.4468	11204.	0.500
42967.	0.4536	0.4592	11204.	0.500
44255.	0.4695	0.4682	11204.	0.500
44814.	0.4741	0.4835	11204.	0.500
46123.	0.4877	0.4964	11204.	0.500
47374.	0.5003	0.5120	11204.	0.500
48418.	0.5114	0.5242	11204.	0.500
50139.	0.5415	0.5472	11204.	0.500
51063.	0.5540	0.5597	11108.	0.500
51959.	0.5684	0.5722	11108.	0.500
52973.	0.5832	0.5841	11108.	0.500
53875.	0.5961	0.5995	11108.	0.500
54490.	0.6113	0.6108	11108.	0.500
55192.	0.6262	0.6234	11096.	0.500
56021.	0.6406	0.6351	11096.	0.500
56644.	0.6552	0.6442	11108.	0.500
57100.	0.6602	0.6597	11096.	0.500
57694.	0.6736	0.6693	11096.	0.500
58241.	0.6825	0.6797	11096.	0.500
58943.	0.6954	0.6949	11084.	0.500
59685.	0.7106	0.7063	11084.	0.500
60156.	0.7242	0.7207	11071.	0.500
60657.	0.7401	0.7271	11071.	0.500
61065.	0.7551	0.7397	11084.	0.500
61536.	0.7684	0.7538	11071.	0.500
61753.	0.7765	0.7586	11071.	0.500
62071.	0.7877	0.7711	11060.	0.500
62487.	0.8006	0.7819	11071.	0.500
62866.	0.8128	0.7943	11060.	0.500
63293.	0.8272	0.8087	11084.	0.500
63663.	0.8354	0.8241	11060.	0.500
64232.	0.8476	0.8404	11071.	0.500
64609.	0.8595	0.8541	11120.	0.500
64790.	0.8672	0.8632	11132.	0.500
65133.	0.8999	0.8756	11120.	0.500
65553.	0.9084	0.8912	11120.	0.500
65556.	0.9183	0.9045	11132.	0.500
65708.	0.9334	0.9140	11108.	0.500
65934.	0.9409	0.9296	11120.	0.500
66064.	0.9491	0.9452	11120.	0.500

TABLE 5-54. CRACK GROWTH DATA SPECIMEN GT160KAB49-37 S/N 1

CYCLE #	CRACK LENGTH (INS.)		MAX STRESS (PSI)	STRESS RATIO	AVERAGE
	LEFT	RIGHT			
111.	0.2693	0.3086	7030	- .336	31236.
776.	0.2703	0.3105	7018	- .326	31861.
1494.	0.2715	0.3134	6994	- .337	32420.
1734.	0.2717	0.3148	7030	- .337	32867.
2392.	0.2725	0.3195	7018	- .328	33522.
3440.	0.2734	0.3233	7030	- .336	34038.
5112.	0.2772	0.3301	7006	- .337	34485.
5961.	0.2788	0.3321	7030	- .336	35061.
6770.	0.2821	0.3364	7018	- .336	35391.
6966.	0.2826	0.3382	7030	- .336	35950.
7331	0.2837	0.3395	7006	- .335	36332.
7655	0.2856	0.3433	7006	- .335	36850.
7755.	0.2860	0.3442	7006	- .337	37298.
7858.	0.2863	0.3446	7018	- .336	37747.
8249	0.2866	0.3458	7018	- .337	38233.
8378.	0.2873	0.3454	7006	- .336	38714.
8499.	0.2878	0.3462	7018	- .334	39161.
8931.	0.2891	0.3470	7018	- .337	39608.
9190.	0.2897	0.3493	7006	- .336	40089.
9319.	0.2906	0.3500	7030	- .337	40570.
9805.	0.2912	0.3526	7018	- .334	41016.
10259.	0.2953	0.3537	7006	- .336	41430.
11136.	0.2980	0.3572	7042	- .332	41877.
12112.	0.3024	0.3635	7030	- .336	42323.
12533.	0.3065	0.3698	7018	- .334	42873.
13359.	0.3072	0.3723	7006	- .337	43250.
13635.	0.3084	0.3734	7018	- .336	43696.
14381.	0.3117	0.3767	7006	- .338	44006.
15080.	0.3150	0.3822	7006	- .335	44352.
15436.	0.3174	0.3865	7018	- .338	44804.
15560.	0.3193	0.3880	7006	- .337	45250.
15924.	0.3198	0.3883	7006	- .338	45593.
16168.	0.3217	0.3902	7006	- .337	45935.
16874.	0.3229	0.3928	7030	- .336	46281.
18940.	0.3282	0.4024	7018	- .338	46602.
19120.	0.3305	0.4053	6970	- .337	46960.
19961.	0.3317	0.4072	6994	- .336	47313.
22211.	0.3370	0.4153	6994	- .333	47727.
23167.	0.3624	0.4421	7006	- .334	48109.
24466.	0.3705	0.4556	6994	- .337	48419.
5000.	0.3774	0.4571	6982	- .340	48810.
6126.	0.3852	0.4653	6994	- .335	49108.
6713.	0.3934	0.4689	6994	- .335	49520.
7204.	0.4010	0.4758	6994	- .335	49842.
7921.	0.4096	0.4793	7078	- .337	50266.
8334.	0.4143	0.4836	6994	- .333	50645.
8958.	0.4216	0.4962	7018	- .334	50922.
9430.	0.4305	0.5036	6994	- .336	51299.
9269.	0.4375	0.5112	6982	- .336	51607.
					51860.
					52188.
					52496.
					52737.
					52908.
					53190.
					53467.
					53887.
					54245.
					54651.
					55062.
					55476.
					55892.
					56306.
					56720.
					57134.
					57548.
					57962.
					58376.
					58790.
					59204.
					59618.
					60032.
					6044

TABLE 5-55. CRACK GROWTH DATA SPECIMEN GT160KAB49-37 S/N 2

CYCLE #	CRACK LENGTH (INS)			MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT	AVERAGE		
2783	0.2377	0.2458	0.2417	11901.	-307
3058	0.2411	0.2636	0.2524	11877.	-306
3507	0.2526	0.2808	0.2667	11889.	-306
3991	0.2578	0.3022	0.2800	11865.	-307
4370	0.2688	0.3218	0.2953	11853.	-307
4680	0.2827	0.3460	0.3144	11889.	-307
5068	0.2925	0.3647	0.3286	11877.	-307
5381	0.3016	0.3809	0.3412	11877.	-307
5726	0.3090	0.3981	0.3535	11877.	-308
6024	0.3219	0.4137	0.3678	11889.	-306
6377	0.3217	0.4325	0.3806	11889.	-306
6866	0.3415	0.4491	0.3953	11901.	-306
7179	0.3474	0.4657	0.4066	11989.	-307
7401	0.3521	0.4842	0.4181	11913.	-306
7747	0.3591	0.5058	0.4325	11889.	-306
8090	0.3631	0.5232	0.4432	11877.	-307
8537	0.3709	0.5424	0.4566	11877.	-307
8950	0.3790	0.5589	0.4689	11877.	-306
9119	0.3817	0.5744	0.4780	11877.	-307
9535	0.3874	0.5944	0.4909	11889.	-305
9912	0.3919	0.6122	0.5021	11877.	-307
10255	0.4140	0.6266	0.5203	11889.	-305
10539	0.4357	0.6388	0.5372	11901.	-306
10733	0.4544	0.6635	0.5589	11877.	-309
10834	0.4868	0.6690	0.5779	11889.	-307
11075	0.5245	0.6918	0.6082	11877.	-305
11175	0.5580	0.6994	0.6287	11901.	-304
11379	0.5836	0.7157	0.6497	11865.	-308
11618	0.6189	0.7318	0.6753	11889.	-309
11857	0.6326	0.7531	0.6928	11877.	-307
12165	0.6416	0.7724	0.7070	11865.	-307
12411	0.6447	0.7950	0.7198	11877.	-306
1255	0.6527	0.8193	0.7356	11889.	-305
126	0.6930	0.8250	0.7595	11889.	-305
1267	0.7233	0.8356	0.7794	11889.	-306
12982	0.7569	0.9226	0.8397	11901.	-307
13255	0.7878	0.9477	0.8677	11889.	-305
13390	0.8211	0.9663	0.8937	11865.	-308
13493	0.8624	0.9849	0.9237	11889.	-305
13627	0.9214	1.0195	0.9704	11977.	-308
13762	0.9548	1.0507	1.0027	11865.	-307
13897	0.9784	1.0997	1.0390	11877.	-308
13997	1.0980	1.1418	1.1199	11865.	-309
14097	1.3047	1.2522	1.2785	11877.	-306

TABLE 5-56. CRACK GROWTH DATA SPECIMEN GT160KAB49-37 S/N 3

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT AVERAGE		
3169.	0.2870	0.2814	6987.	-506
5272.	0.2946	0.2873	6975.	-509
7193.	0.3022	0.2926	6987.	-504
8729.	0.3098	0.2992	6987.	-508
10363.	0.3172	0.3044	6951.	-509
12317.	0.3244	0.3109	7023.	-507
14089.	0.3321	0.3184	6987.	-506
15579.	0.3398	0.3250	6987.	-508
17278.	0.3470	0.3335	6999.	-510
18731.	0.3547	0.3387	6975.	-510
20149.	0.3621	0.3468	6975.	-510
21532.	0.3697	0.3535	6975.	-509
22880.	0.3772	0.3610	6987.	-508
24124.	0.3830	0.3696	6987.	-508
25401.	0.3905	0.3766	6987.	-508
26713.	0.3977	0.3845	6975.	-505
27853.	0.4045	0.3900	6999.	-507
28820.	0.4078	0.3986	6975.	-507
29961.	0.4139	0.4072	6987.	-504
31040.	0.4215	0.4152	6975.	-505
32043.	0.4295	0.4227	6983.	-509
32923.	0.4373	0.4277	6987.	-503
33958.	0.4445	0.4357	6987.	-506
35041.	0.4514	0.4448	6963.	-509
35975.	0.4584	0.4515	6975.	-505
36944.	0.4662	0.4587	6975.	-505
37881.	0.4737	0.4650	6999.	-507
38505.	0.4815	0.4738	6999.	-507
39234.	0.4893	0.4822	6963.	-509
40348.	0.4971	0.4910	6975.	-507
41021.	0.5025	0.4995	6987.	-506
41693.	0.5089	0.5077	6963.	-509
42530.	0.5165	0.5101	6999.	-509
43108.	0.5224	0.5269	6987.	-508
43472.	0.5296	0.5348	6975.	-507
44437.	0.5370	0.5434	6987.	-504
45297.	0.5421	0.5527	6999.	-507
45729.	0.5496	0.5610	6975.	-509
46419.	0.5560	0.5717	6987.	-506
47113.	0.5641	0.5799	7014.	-504
47773.	0.5696	0.5886	6999.	-505
48431.	0.5772	0.5937	6987.	-506
48981.	0.5824	0.6025	6963.	-508
49253.	0.5906	0.6085	6999.	-505
49840.	0.5990	0.6177	6987.	-508
50494.	0.6069	0.6251	7083.	-521
50939.	0.6130	0.6342	6987.	-508
51419.	0.6195	0.6438	6963.	-508
51898.	0.6245	0.6561	6987.	-508
52413.	0.6318	0.6587	6975.	-507
52854.	0.6391	0.6700	7114.	-506
53445.	0.6449	0.6766	6999.	-505

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT AVERAGE		
1	0.00	0.00	10000	0.00
2	0.00	0.00	10000	0.00
3	0.00	0.00	10000	0.00
4	0.00	0.00	10000	0.00
5	0.00	0.00	10000	0.00
6	0.00	0.00	10000	0.00
7	0.00	0.00	10000	0.00
8	0.00	0.00	10000	0.00
9	0.00	0.00	10000	0.00
10	0.00	0.00	10000	0.00
11	0.00	0.00	10000	0.00
12	0.00	0.00	10000	0.00
13	0.00	0.00	10000	0.00
14	0.00	0.00	10000	0.00
15	0.00	0.00	10000	0.00
16	0.00	0.00	10000	0.00
17	0.00	0.00	10000	0.00
18	0.00	0.00	10000	0.00
19	0.00	0.00	10000	0.00
20	0.00	0.00	10000	0.00
21	0.00	0.00	10000	0.00
22	0.00	0.00	10000	0.00
23	0.00	0.00	10000	0.00
24	0.00	0.00	10000	0.00
25	0.00	0.00	10000	0.00
26	0.00	0.00	10000	0.00
27	0.00	0.00	10000	0.00
28	0.00	0.00	10000	0.00
29	0.00	0.00	10000	0.00
30	0.00	0.00	10000	0.00
31	0.00	0.00	10000	0.00
32	0.00	0.00	10000	0.00
33	0.00	0.00	10000	0.00
34	0.00	0.00	10000	0.00
35	0.00	0.00	10000	0.00
36	0.00	0.00	10000	0.00
37	0.00	0.00	10000	0.00
38	0.00	0.00	10000	0.00
39	0.00	0.00	10000	0.00
40	0.00	0.00	10000	0.00
41	0.00	0.00	10000	0.00
42	0.00	0.00	10000	0.00
43	0.00	0.00	10000	0.00
44	0.00	0.00	10000	0.00
45	0.00	0.00	10000	0.00
46	0.00	0.00	10000	0.00
47	0.00	0.00	10000	0.00
48	0.00	0.00	10000	0.00
49	0.00	0.00	10000	0.00
50	0.00	0.00	10000	0.00
51	0.00	0.00	10000	0.00
52	0.00	0.00	10000	0.00
53	0.00	0.00	10000	0.00
54	0.00	0.00	10000	0.00
55	0.00	0.00	10000	0.00
56	0.00	0.00	10000	0.00
57	0.00	0.00	10000	0.00
58	0.00	0.00	10000	0.00
59	0.00	0.00	10000	0.00
60	0.00	0.00	10000	0.00
61	0.00	0.00	10000	0.00
62	0.00	0.00	10000	0.00
63	0.00	0.00	10000	0.00
64	0.00	0.00	10000	0.00
65	0.00	0.00	10000	0.00
66	0.00	0.00	10000	0.00
67	0.00	0.00	10000	0.00
68	0.00	0.00	10000	0.00
69	0.00	0.00	10000	0.00
70	0.00	0.00	10000	0.00
71	0.00	0.00	10000	0.00
72	0.00	0.00		

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TABLE 5-58. CRACK GROWTH DATA SPECIMEN GT160KAB49-15 S/N 1

CYCLE ν	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT		
1.	0.4385	0.4385	6675.	0.050
3031.	0.4547	0.4547	6681.	0.050
3087.	0.4709	0.4709	6682.	0.050
5479.	0.4956	0.4956	6682.	0.050
6205.	0.5037	0.5037	6682.	0.050
9721.	0.5350	0.5350	6680.	0.050
10813.	0.5512	0.5512	6682.	0.050
12312.	0.5667	0.5667	6688.	0.050
13689.	0.5833	0.5833	6682.	0.050
14753.	0.5992	0.5992	6680.	0.050
16391.	0.6145	0.6145	6688.	0.050
17698.	0.6307	0.6307	6688.	0.050
18571.	0.6474	0.6474	6688.	0.050
20101.	0.6633	0.6633	6688.	0.050
21218.	0.6791	0.6791	6688.	0.050
22277.	0.6956	0.6956	6621.	0.050
22845.	0.7116	0.7116	6621.	0.050
25248.	0.7280	0.7280	6621.	0.050
26382.	0.7444	0.7444	6612.	0.050
27435.	0.7604	0.7604	6612.	0.050
28816.	0.7772	0.7772	6612.	0.050
29044.	0.7934	0.7934	6612.	0.050
29791.	0.8091	0.8091	6612.	0.050
30539.	0.8250	0.8250	6612.	0.050
31390.	0.8409	0.8409	6612.	0.050
32361.	0.8568	0.8568	6600.	0.050
33422.	0.8726	0.8726	6796.	0.050
34481.	0.8888	0.8888	6788.	0.050
35368.	0.9046	0.9046	6788.	0.050
36492.	0.9205	0.9205	6762.	0.050
37433.	0.9363	0.9363	6762.	0.050
38364.	0.9522	0.9522	6762.	0.050

TABLE 5-59. CRACK GROWTH DATA SPECIMEN GT160KAB49-15 S/N 2

CYCLE #	CRACK LENGTH (INS)			MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT	AVERAGE		
2022.	0.2292	0.2840	0.2566	10729.	0.050
3111.	0.2448	0.3001	0.2724	10754.	0.050
4419.	0.2653	0.3172	0.2912	10729.	0.050
5374.	0.2844	0.3328	0.3086	10729.	0.050
6303.	0.3010	0.3480	0.3245	10779.	0.050
7249.	0.3171	0.3641	0.3406	10754.	0.050
8548.	0.3362	0.3797	0.3579	10779.	0.050
9449.	0.3547	0.3944	0.3745	10779.	0.050
10497.	0.3728	0.4119	0.3924	10754.	0.050
11357.	0.3909	0.4300	0.4104	10779.	0.050
12270.	0.4075	0.4486	0.4280	10779.	0.050
13204.	0.4265	0.4613	0.4439	10754.	0.050
14081.	0.4412	0.4795	0.4605	10766.	0.050
14985.	0.4573	0.4974	0.4774	10729.	0.050
15745.	0.4773	0.5097	0.4935	10716.	0.050
16471.	0.4969	0.5214	0.5091	10729.	0.050
16839.	0.5057	0.5419	0.5238	10729.	0.050
17534.	0.5262	0.5375	0.5319	10729.	0.050
18098.	0.5389	0.5780	0.5585	10729.	0.050
18525.	0.5516	0.5986	0.5751	10716.	0.050
19169.	0.5677	0.6186	0.5932	10729.	0.050
19848.	0.5887	0.6303	0.6095	10704.	0.050
20366.	0.6004	0.6508	0.6256	10716.	0.050
20836.	0.6136	0.6714	0.6425	10716.	0.050
21425.	0.6322	0.6899	0.6611	10704.	0.050
21932.	0.6527	0.7046	0.6786	10704.	0.050
22570.	0.6732	0.7148	0.6940	10704.	0.050
23291.	0.6937	0.7305	0.7121	10692.	0.050
23741.	0.7143	0.7388	0.7265	10704.	0.050
24202.	0.7348	0.7641	0.7395	10679.	0.050
24591.	0.7524	0.7612	0.7568	10704.	0.050
25153.	0.7714	0.7764	0.7739	10679.	0.050
25324.	0.7919	0.7827	0.7873	10679.	0.050
25975.	0.8120	0.7949	0.8035	10679.	0.050
26286.	0.8320	0.8062	0.8196	10679.	0.050
26601.	0.8515	0.8213	0.8364	10679.	0.050
26760.	0.8574	0.8418	0.8496	10679.	0.050
26983.	0.8662	0.8624	0.8643	10679.	0.050
27172.	0.8818	0.8795	0.8806	10679.	0.050
27320.	0.8857	0.9000	0.8929	10679.	0.050
27569.	0.9033	0.9054	0.9043	10679.	0.050
27791.	0.9131	0.9259	0.9195	10667.	0.050
28037.	0.9307	0.9435	0.9371	10667.	0.050
28209.	0.9390	0.9640	0.9515	10654.	0.050
28376.	0.9463	0.9845	0.9654	10654.	0.050
28433.	0.9585	1.0055	0.9820	10647.	0.050
28546.	0.9639	1.0363	1.0001	10654.	0.050
28808.	0.9844	1.0192	1.0018	10754.	0.050
28978.	0.9966	1.0333	1.0150	10704.	0.050
29222.	1.0049	1.0539	1.0294	10704.	0.050
29325.	1.0162	1.0754	1.0458	10692.	0.050
29476.	1.0299	1.0964	1.0631	10679.	0.050
29542.	1.0377	1.1169	1.0773	10679.	0.050
29761.	1.0313	1.1232	1.0823	10667.	0.050
29809.	1.0626	1.1447	1.1037	10679.	0.050
29848.	1.0694	1.1740	1.1217	10679.	0.050

TABLE 5-60. CRACK GROWTH DATA SPECIMEN GT160KAB49-15 S/N 3

CYCLE #	LEFT	CRACK LENGTH (INS)	MAX STRESS (PSI)	STRESS RATIO
19038	0.2876	0.2728	6999	0.4408
31042	0.2963	0.2821	6462	0.4431
37633	0.2963	0.2910	6462	0.4431
71343	0.3015	0.2998	6462	0.4431
91390	0.3123	0.3061	6462	0.4431
101005	0.3195	0.3120	6462	0.4431
100108	0.3287	0.3165	6462	0.4431
111878	0.3375	0.3154	6462	0.4431
115193	0.3462	0.3179	6462	0.4431
127979	0.3554	0.3224	6462	0.4431
135545	0.3644	0.3297	6462	0.4431
135916	0.3724	0.3364	6462	0.4431
167010	0.3728	0.3433	6462	0.4431
182934	0.3876	0.3529	6462	0.4431
189749	0.3930	0.3621	6462	0.4431
213638	0.3997	0.3710	6462	0.4431
225012	0.4089	0.3760	6462	0.4431
237531	0.4156	0.3849	6462	0.4431
254350	0.4231	0.3937	6462	0.4431
264207	0.4306	0.4004	6462	0.4431
274676	0.4365	0.4084	6462	0.4431
280744	0.4434	0.4163	6462	0.4431
297891	0.4494	0.4234	6462	0.4431
307094	0.4544	0.4294	6462	0.4431
313940	0.4632	0.4358	6462	0.4431
323243	0.4695	0.4433	6462	0.4431
331821	0.4764	0.4510	6462	0.4431
344804	0.4837	0.4598	6462	0.4431
353077	0.4924	0.4640	6462	0.4431
364321	0.4970	0.4723	6462	0.4431
373533	0.5018	0.4809	6462	0.4431
383646	0.5091	0.4897	6462	0.4431
396217	0.5183	0.4978	6462	0.4431
403880	0.5254	0.5034	6462	0.4431
414400	0.5334	0.5125	6462	0.4431
420008	0.5420	0.5213	6462	0.4431
426279	0.5512	0.5289	6462	0.4431
433616	0.5613	0.5361	6462	0.4431
439404	0.5701	0.5432	6462	0.4431
450321	0.5760	0.5520	6462	0.4431
458294	0.5818	0.5609	6462	0.4431
462757	0.5897	0.5697	6462	0.4431
465666	0.5985	0.5764	6462	0.4431
471930	0.6056	0.5832	6462	0.4431
479746	0.6127	0.5920	6462	0.4431
484034	0.6177	0.6009	6462	0.4431
489506	0.6232	0.6097	6462	0.4431
493578	0.6319	0.6144	6462	0.4431
497268	0.6382	0.6232	6462	0.4431
501215	0.6470	0.6299	6462	0.4431
504850	0.6542	0.6356	6462	0.4431
512181	0.6608	0.6431	6462	0.4431
517977	0.6695	0.6504	6462	0.4431
521530	0.6781	0.6579	6462	0.4431
523735	0.6866	0.6654	6462	0.4431
526883	0.6954	0.6731	6462	0.4431
531741	0.7042	0.6818	6462	0.4431
535321	0.7130	0.6906	6462	0.4431
537934	0.7218	0.6994	6462	0.4431
540910	0.7306	0.7082	6462	0.4431
543991	0.7394	0.7170	6462	0.4431
549564	0.7482	0.7258	6462	0.4431
552641	0.7570	0.7346	6462	0.4431
554740	0.7658	0.7434	6462	0.4431
559931	0.7746	0.7522	6462	0.4431
561139	0.7834	0.7610	6462	0.4431
563576	0.7922	0.7698	6462	0.4431
565794	0.8010	0.7786	6462	0.4431
568788	0.8098	0.7874	6462	0.4431
572740	0.8186	0.7962	6462	0.4431
575060	0.8274	0.8050	6462	0.4431
577215	0.8362	0.8138	6462	0.4431
580941	0.8450	0.8226	6462	0.4431
583581	0.8538	0.8314	6462	0.4431
586667	0.8626	0.8402	6462	0.4431
587634	0.8714	0.8490	6462	0.4431
590237	0.8802	0.8578	6462	0.4431
592968	0.8890	0.8666	6462	0.4431
593758	0.8978	0.8754	6462	0.4431
594358	0.9066	0.8842	6462	0.4431
594355	0.9154	0.8930	6462	0.4431
594571	0.9242	0.9018	6462	0.4431
600921	0.9330	0.9106	6462	0.4431
602999	0.9418	0.9194	6462	0.4431
604784	0.9506	0.9282	6462	0.4431
606085	0.9594	0.9370	6462	0.4431
607634	0.9682	0.9458	6462	0.4431
608944	0.9770	0.9546	6462	0.4431
610311	0.9858	0.9634	6462	0.4431
611464	0.9946	0.9722	6462	0.4431
612491	1.0034	0.9810	6462	0.4431
613191	1.0122	0.9898	6462	0.4431
614151	1.0210	0.9986	6462	0.4431
616178	1.0298	1.0074	6462	0.4431
617331	1.0386	1.0162	6462	0.4431
618433	1.0474	1.0250	6462	0.4431
619485	1.0562	1.0338	6462	0.4431
621026	1.0650	1.0426	6462	0.4431
623344	1.0738	1.0514	6462	0.4431
625348	1.0826	1.0602	6462	0.4431
626332	1.0914	1.0690	6462	0.4431
627342	1.1002	1.0778	6462	0.4431
628393	1.1090	1.0866	6462	0.4431
629544	1.1178	1.0954	6462	0.4431
630642	1.1266	1.1042	6462	0.4431
631742	1.1354	1.1130	6462	0.4431
632842	1.1442	1.1218	6462	0.4431
633942	1.1530	1.1306	6462	0.4431
635042	1.1618	1.1394	6462	0.4431
636142	1.1706	1.1482	6462	0.4431
637242	1.1794	1.1570	6462	0.4431
638342	1.1882	1.1658	6462	0.4431
639442	1.1970	1.1746	6462	0.4431
640542	1.2058	1.1834	6462	0.4431
641642	1.2146	1.1922	6462	0.4431
642742	1.2234	1.2010	6462	0.4431
643842	1.2322	1.2098	6462	0.4431
644942	1.2410	1.2186	6462	0.4431
646042	1.2498	1.2274	6462	0.4431
647142	1.2586	1.2362	6462	0.4431
648242	1.2674	1.2450	6462	0.4431
649342	1.2762	1.2538	6462	0.4431
650442	1.2850	1.2626	6462	0.4431
651542	1.2938	1.2714	6462	0.4431
652642	1.3026	1.2802	6462	0.4431
653742	1.3114	1.2890	6462	0.4431
654842	1.3202	1.2978	6462	0.4431
655942	1.3290	1.3066	6462	0.4431
657042	1.3378	1.3154	6462	0.4431
658142	1.3466	1.3242	6462	0.4431
659242	1.3554	1.3330	6462	0.4431
660342	1.3642	1.3418	6462	0.4431
661442	1.3730	1.3506	6462	0.4431
662542	1.3818	1.3594	6462	0.4431
663642	1.3906	1.3682	6462	0.4431
664742	1.3994	1.3770	6462	0.4431
665842	1.4082	1.3858	6462	0.4431
666942	1.4170	1.3946	6462	0.4431
668042	1.4258	1.4034	6462	0.4431
669142	1.4346	1.4122	6462	0.4431
670242	1.4434	1.4210	6462	0.4431
671342	1.4522	1.4298	6462	0.4431
672442	1.4610	1.4386	6462	0.4431
673542	1.4698	1.4474	6462	0.4431
674642	1.4786	1.4562	6462	0.4431
675742	1.4874	1.4650	6462	0.4431
676842	1.4962	1.4738	6462	0.4431
677942	1.5050	1.4826	6462	0.4431
679042	1.5138	1.4914	6462	0.4431
680142	1.5226	1.5002	6462	0.4431
681242	1.5314	1.5090	6462	0.4431
682342	1.5402	1.5178	6462	0.4431
683442	1.5490	1.5266	6462	0.4431
684542	1.5578	1.5354	6462	0.4431
685642	1.5666	1.5442	6462	0.4431
686742	1.5754	1.5530	6462	0.4431
687842	1.5842	1.5618	6462	0.4431
688942	1.5930	1.5706	6462	0.4431
690042	1.6018	1.5794	6462	0.4431
691142	1.6106	1.5882	6462	0.4431
692242	1.6194	1.5970	6462	0.4431
693342	1.6282	1.6058	6462	0.4431
694442	1.6370	1.6146	6462	0.4431
695542	1.6458	1.6234	6462	0.4431
696642	1.6546	1.6322	6462	0.4431
697742	1.6634	1.6410	6462	0.4431
698842	1.6722	1.6498	6462	0.4431
699942	1.6810	1.6586	6462	0.4431
701042	1.6898	1.6674	6462	0.4431
702142	1.6986	1.6762	6462	0.4431
703242	1.7074	1.6850	6462	0.4431
704342	1.7162	1.6938	6462	0.4431
705442	1.7250	1.7026	6462	0.4431
706542	1.7338	1.7114	6462	0.4431
707642	1.7426	1.7202	6462	0.4431
708742	1.7514	1.7290	6462	0.4431
709842	1.7602	1.7378	6462	0.4431
710942	1.7690	1.7466	6462	0.4431
712042	1.7778	1.7554	6462	0.4431
713142	1.7866	1.7642	6462	0.4431
714242	1.7954	1.7730	6462	0.4431
715342	1.8042	1.7818	6462	0.4431
716442	1.8130	1.7906	6462	0.4431
717542	1.8218	1.7994	6462	0.4431
718642	1.8306	1.8082	6462	0.4431
719742	1.8394	1.8170	6462	0.4431
720842	1.8482	1.8258	6462	0.4431
721942	1.8570	1.8346	6462	0.4431
723042	1.8658	1.8434	6462	0.4431
724142	1.8746	1.8522	6462	0.4431
725242	1.8834	1.8610	6462	0.4431
726342	1.8922	1.8698	6462	0.4431
727442	1.9010	1.8786	6462	0.4431
728542	1.9098	1.8874	6462	0.4431
729642	1.9186	1.8962	6462	0.4431
730742	1.9274	1.9050	6462	0.4431
731842	1.9362	1.9138	6462	0.4431
732942	1.9450	1.9226	6462	0.4431
734042	1.9538	1.9314	6462	0.4431
735142	1.9626	1.9402	6462	0.4431
736242	1.9714	1.9490	6462	0.4431
737342	1.9802	1.9578	6462	0.4431
738442	1.9890	1.9666	6462	0.4431
739542	1.9978	1.9754	6462	0.4431
740642	2.0066	1.9842	6462	0.4431
741742	2.0154	1.9930	6462	0.4431
742842	2.0242	2.0018	6462	0.4431
743942	2.0330	2.0106		

TABLE 5-62. CRACK GROWTH DATA SPECIMEN GT160KAB49-35 S/N 1

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈	C ₉	C ₁₀	C ₁₁	C ₁₂	C ₁₃	C ₁₄	C ₁₅	C ₁₆	C ₁₇	C ₁₈	C ₁₉	C ₂₀	C ₂₁	C ₂₂	C ₂₃	C ₂₄	C ₂₅	C ₂₆	C ₂₇	C ₂₈	C ₂₉	C ₃₀	C ₃₁	C ₃₂	C ₃₃	C ₃₄	C ₃₅	C ₃₆	C ₃₇	C ₃₈	C ₃₉	C ₄₀	C ₄₁	C ₄₂	C ₄₃	C ₄₄	C ₄₅	C ₄₆	C ₄₇	C ₄₈	C ₄₉	C ₅₀	C ₅₁	C ₅₂	C ₅₃	C ₅₄	C ₅₅	C ₅₆	C ₅₇	C ₅₈	C ₅₉	C ₆₀	C ₆₁	C ₆₂	C ₆₃	C ₆₄	C ₆₅	C ₆₆	C ₆₇	C ₆₈	C ₆₉	C ₇₀	C ₇₁	C ₇₂	C ₇₃	C ₇₄	C ₇₅	C ₇₆	C ₇₇	C ₇₈	C ₇₉	C ₈₀	C ₈₁	C ₈₂	C ₈₃	C ₈₄	C ₈₅	C ₈₆	C ₈₇	C ₈₈	C ₈₉	C ₉₀	C ₉₁	C ₉₂	C ₉₃	C ₉₄	C ₉₅	C ₉₆	C ₉₇	C ₉₈	C ₉₉	C ₁₀₀	C ₁₀₁	C ₁₀₂	C ₁₀₃	C ₁₀₄	C ₁₀₅	C ₁₀₆	C ₁₀₇	C ₁₀₈	C ₁₀₉	C ₁₁₀	C ₁₁₁	C ₁₁₂	C ₁₁₃	C ₁₁₄	C ₁₁₅	C ₁₁₆	C ₁₁₇	C ₁₁₈	C ₁₁₉	C ₁₂₀	C ₁₂₁	C ₁₂₂	C ₁₂₃	C ₁₂₄	C ₁₂₅	C ₁₂₆	C ₁₂₇	C ₁₂₈	C ₁₂₉	C ₁₃₀	C ₁₃₁	C ₁₃₂	C ₁₃₃	C ₁₃₄	C ₁₃₅	C ₁₃₆	C ₁₃₇	C ₁₃₈	C ₁₃₉	C ₁₄₀	C ₁₄₁	C ₁₄₂	C ₁₄₃	C ₁₄₄	C ₁₄₅	C ₁₄₆	C ₁₄₇	C ₁₄₈	C ₁₄₉	C ₁₅₀	C ₁₅₁	C ₁₅₂	C ₁₅₃	C ₁₅₄	C ₁₅₅	C ₁₅₆	C ₁₅₇	C ₁₅₈	C ₁₅₉	C ₁₆₀	C ₁₆₁	C ₁₆₂	C ₁₆₃	C ₁₆₄	C ₁₆₅	C ₁₆₆	C ₁₆₇	C ₁₆₈	C ₁₆₉	C ₁₇₀	C ₁₇₁	C ₁₇₂	C ₁₇₃	C ₁₇₄	C ₁₇₅	C ₁₇₆	C ₁₇₇	C ₁₇₈	C ₁₇₉	C ₁₈₀	C ₁₈₁	C ₁₈₂	C ₁₈₃	C ₁₈₄	C ₁₈₅	C ₁₈₆	C ₁₈₇	C ₁₈₈	C ₁₈₉	C ₁₉₀	C ₁₉₁	C ₁₉₂	C ₁₉₃	C ₁₉₄	C ₁₉₅	C ₁₉₆	C ₁₉₇	C ₁₉₈	C ₁₉₉	C ₂₀₀	C ₂₀₁	C ₂₀₂	C ₂₀₃	C ₂₀₄	C ₂₀₅	C ₂₀₆	C ₂₀₇	C ₂₀₈	C ₂₀₉	C ₂₁₀	C ₂₁₁	C ₂₁₂	C ₂₁₃	C ₂₁₄	C ₂₁₅	C ₂₁₆	C ₂₁₇	C ₂₁₈	C ₂₁₉	C ₂₂₀	C ₂₂₁	C ₂₂₂	C ₂₂₃	C ₂₂₄	C ₂₂₅	C ₂₂₆	C ₂₂₇	C ₂₂₈	C ₂₂₉	C ₂₃₀	C ₂₃₁	C ₂₃₂	C ₂₃₃	C ₂₃₄	C ₂₃₅	C ₂₃₆	C ₂₃₇	C ₂₃₈	C ₂₃₉	C ₂₄₀	C ₂₄₁	C ₂₄₂	C ₂₄₃	C ₂₄₄	C ₂₄₅	C ₂₄₆	C ₂₄₇	C ₂₄₈	C ₂₄₉	C ₂₅₀	C ₂₅₁	C ₂₅₂	C ₂₅₃	C ₂₅₄	C ₂₅₅	C ₂₅₆	C ₂₅₇	C ₂₅₈	C ₂₅₉	C ₂₆₀	C ₂₆₁	C ₂₆₂	C ₂₆₃	C ₂₆₄	C ₂₆₅	C ₂₆₆	C ₂₆₇	C ₂₆₈	C ₂₆₉	C ₂₇₀	C ₂₇₁	C ₂₇₂	C ₂₇₃	C ₂₇₄	C ₂₇₅	C ₂₇₆	C ₂₇₇	C ₂₇₈	C ₂₇₉	C ₂₈₀	C ₂₈₁	C ₂₈₂	C ₂₈₃	C ₂₈₄	C ₂₈₅	C ₂₈₆	C ₂₈₇	C ₂₈₈	C ₂₈₉	C ₂₉₀	C ₂₉₁	C ₂₉₂	C ₂₉₃	C ₂₉₄	C ₂₉₅	C ₂₉₆	C ₂₉₇	C ₂₉₈	C ₂₉₉	C ₃₀₀	C ₃₀₁	C ₃₀₂	C ₃₀₃	C ₃₀₄	C ₃₀₅	C ₃₀₆	C ₃₀₇	C ₃₀₈	C ₃₀₉	C ₃₁₀	C ₃₁₁	C ₃₁₂	C ₃₁₃	C ₃₁₄	C ₃₁₅	C ₃₁₆	C ₃₁₇	C ₃₁₈	C ₃₁₉	C ₃₂₀	C ₃₂₁	C ₃₂₂	C ₃₂₃	C ₃₂₄	C ₃₂₅	C ₃₂₆	C ₃₂₇	C ₃₂₈	C ₃₂₉	C ₃₃₀	C ₃₃₁	C ₃₃₂	C ₃₃₃	C ₃₃₄	C ₃₃₅	C ₃₃₆	C ₃₃₇	C ₃₃₈	C ₃₃₉	C ₃₄₀	C ₃₄₁	C ₃₄₂	C ₃₄₃	C ₃₄₄	C ₃₄₅	C ₃₄₆	C ₃₄₇	C ₃₄₈	C ₃₄₉	C ₃₅₀	C ₃₅₁	C ₃₅₂	C ₃₅₃	C ₃₅₄	C ₃₅₅	C ₃₅₆	C ₃₅₇	C ₃₅₈	C ₃₅₉	C ₃₆₀	C ₃₆₁	C ₃₆₂	C ₃₆₃	C ₃₆₄	C ₃₆₅	C ₃₆₆	C ₃₆₇	C ₃₆₈	C ₃₆₉	C ₃₇₀	C ₃₇₁	C ₃₇₂	C ₃₇₃	C ₃₇₄	C ₃₇₅	C ₃₇₆	C ₃₇₇	C ₃₇₈	C ₃₇₉	C ₃₈₀	C ₃₈₁	C ₃₈₂	C ₃₈₃	C ₃₈₄	C ₃₈₅	C ₃₈₆	C ₃₈₇	C ₃₈₈	C ₃₈₉	C ₃₉₀	C ₃₉₁	C ₃₉₂	C ₃₉₃	C ₃₉₄	C ₃₉₅	C ₃₉₆	C ₃₉₇	C ₃₉₈	C ₃₉₉	C ₄₀₀	C ₄₀₁	C ₄₀₂	C ₄₀₃	C ₄₀₄	C ₄₀₅	C ₄₀₆	C ₄₀₇	C ₄₀₈	C ₄₀₉	C ₄₁₀	C ₄₁₁	C ₄₁₂	C ₄₁₃	C ₄₁₄	C ₄₁₅	C ₄₁₆	C ₄₁₇	C ₄₁₈	C ₄₁₉	C ₄₂₀	C ₄₂₁	C ₄₂₂	C ₄₂₃	C ₄₂₄	C ₄₂₅	C ₄₂₆	C ₄₂₇	C ₄₂₈	C ₄₂₉	C ₄₃₀	C ₄₃₁	C ₄₃₂	C ₄₃₃	C ₄₃₄	C ₄₃₅	C ₄₃₆	C ₄₃₇	C ₄₃₈	C ₄₃₉	C ₄₄₀	C ₄₄₁	C ₄₄₂	C ₄₄₃	C ₄₄₄	C ₄₄₅	C ₄₄₆	C ₄₄₇	C ₄₄₈	C ₄₄₉	C ₄₅₀	C ₄₅₁	C ₄₅₂	C ₄₅₃	C ₄₅₄	C ₄₅₅	C ₄₅₆	C ₄₅₇	C ₄₅₈	C ₄₅₉	C ₄₆₀	C ₄₆₁	C ₄₆₂	C ₄₆₃	C ₄₆₄	C ₄₆₅	C ₄₆₆	C ₄₆₇	C ₄₆₈	C ₄₆₉	C ₄₇₀	C ₄₇₁	C ₄₇₂	C ₄₇₃	C ₄₇₄	C ₄₇₅	C ₄₇₆	C ₄₇₇	C ₄₇₈	C ₄₇₉	C ₄₈₀	C ₄₈₁	C ₄₈₂	C ₄₈₃	C ₄₈₄	C ₄₈₅	C ₄₈₆	C ₄₈₇	C ₄₈₈	C ₄₈₉	C ₄₉₀	C ₄₉₁	C ₄₉₂	C ₄₉₃	C ₄₉₄	C ₄₉₅	C ₄₉₆	C ₄₉₇	C ₄₉₈	C ₄₉₉	C ₅₀₀	C ₅₀₁	C ₅₀₂	C ₅₀₃	C ₅₀₄	C ₅₀₅	C ₅₀₆	C ₅₀₇	C ₅₀₈	C ₅₀₉	C ₅₁₀	C ₅₁₁	C ₅₁₂	C ₅₁
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TABLE 5-63. CRACK GROWTH DATA SPECIMEN GT160KAB49-35 S/N 2

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT AVERAGE		
571.	0.2384	0.2388	11190.	- .300
1371.	0.2445	0.2498	11190.	- .300
1891.	0.2503	0.2602	11190.	- .300
2339.	0.2576	0.2723	11190.	- .300
2960.	0.2689	0.2829	11165.	- .304
3580.	0.2779	0.2943	11190.	- .302
4168.	0.2859	0.3063	11165.	- .303
4884.	0.2920	0.3175	11178.	- .302
5478.	0.3032	0.3284	11178.	- .305
6341.	0.3115	0.3396	11178.	- .301
6716.	0.3170	0.3509	11178.	- .302
7164.	0.3230	0.3627	11202.	- .301
7717.	0.3305	0.3750	11190.	- .302
8406.	0.3420	0.3836	11190.	- .301
8749.	0.3468	0.3942	11190.	- .302
9299.	0.3581	0.4030	11141.	- .303
9849.	0.3698	0.4088	11141.	- .303
10329.	0.3823	0.4196	11190.	- .303
10741.	0.3876	0.4312	11141.	- .301
11224.	0.3985	0.4454	11190.	- .302
11739.	0.4104	0.4569	11178.	- .302
11908.	0.4129	0.4687	11190.	- .311
12076.	0.4213	0.5016	11190.	- .299
12349.	0.4357	0.5231	11190.	- .302
12517.	0.4432	0.5404	11190.	- .299
12653.	0.4551	0.5673	11165.	- .302
12787.	0.4745	0.5790	11165.	- .299
12956.	0.4957	0.5896	11190.	- .304
13055.	0.5318	0.6001	11178.	- .301
13189.	0.5678	0.6179	11190.	- .299
13323.	0.5927	0.6419	11165.	- .304
13328.	0.6045	0.6650	11190.	- .299
13697.	0.6174	0.6855	11178.	- .300
13949.	0.6329	0.6975	11165.	- .302
14276.	0.6506	0.7123	11178.	- .299
14582.	0.6452	0.7266	11178.	- .301
14924.	0.6611	0.7383	11178.	- .300
15050.	0.6682	0.7617	11178.	- .302
15297.	0.6572	0.7718	11190.	- .300
15534.	0.6930	0.7858	11190.	- .301
15688.	0.7086	0.7943	11178.	- .301
15767.	0.7476	0.8060	11190.	- .299
15866.	0.7686	0.8370	11190.	- .299
15966.	0.8428	0.8157	11190.	- .302
16087.	0.9002	0.8259	11190.	- .301
16200.	0.9303	0.8377	11178.	- .305
16299.	0.9395	0.8638	11178.	- .301
16398.	0.9782	0.9725	11165.	- .301
16497.	0.9968	1.0831	11165.	- .303
16597.	1.0312	1.1275	11153.	- .303
16698.	1.0548	1.1471	11165.	- .301
16866.	1.0782	1.1671	11178.	- .301

TABLE 5-64. CRACK GROWTH DATA SPECIMEN GT160KAB49-35 S/N 3

CYCLE #	CRACK LENGTH (INS)		MAX STRESS (PSI)		STRESS RATIO	
	LEFT	RIGHT	AVERAGE	LEFT	RIGHT	AVERAGE
3366.	0.2813	0.2711	0.2762	6798.	- .503	- .503
4634.	0.2926	0.2761	0.2844	6823.	- .503	- .503
5414.	0.2720	0.2905	0.2942	6823.	- .503	- .503
6111.	0.3106	0.3037	0.3081	6823.	- .499	- .499
7085.	0.3225	0.3166	0.3197	6823.	- .501	- .501
7707.	0.3367	0.3260	0.3313	6798.	- .503	- .503
8505.	0.3491	0.3387	0.3429	6835.	- .500	- .500
9382.	0.3582	0.3516	0.3554	6823.	- .503	- .503
10268.	0.3676	0.3661	0.3668	6810.	- .504	- .504
10542.	0.3829	0.3737	0.3783	6835.	- .502	- .502
11441.	0.3970	0.3884	0.3927	6810.	- .500	- .500
12410.	0.4076	0.4026	0.4056	6810.	- .504	- .504
13207.	0.4124	0.4137	0.4151	6823.	- .503	- .503
13376.	0.4311	0.4205	0.4258	6798.	- .506	- .506
14031.	0.4333	0.4244	0.4339	6823.	- .503	- .503
14269.	0.4465	0.4401	0.4443	6798.	- .503	- .503
15028.	0.4482	0.4546	0.4514	6810.	- .504	- .504
15439.	0.4599	0.4612	0.4605	6835.	- .500	- .500
15678.	0.4734	0.4630	0.4692	6823.	- .499	- .499
15953.	0.4907	0.4676	0.4791	6798.	- .503	- .503
16955.	0.4952	0.4826	0.4889	6823.	- .506	- .506
17783.	0.4910	0.4983	0.4946	6823.	- .499	- .499
18334.	0.5023	0.5088	0.5045	6810.	- .502	- .502
18780.	0.5095	0.5273	0.5184	6798.	- .503	- .503
19018.	0.5142	0.5561	0.5652	6823.	- .503	- .503
19813.	0.5229	0.5714	0.5977	6823.	- .503	- .503
20675.	0.5305	0.6868	0.6086	6810.	- .502	- .502
21814.	0.5364	0.7019	0.6192	6823.	- .503	- .503
22710.	0.5403	0.7162	0.6282	6823.	- .503	- .503
23260.	0.5446	0.7305	0.6375	6823.	- .501	- .501
23304.	0.5561	0.7358	0.6464	6798.	- .503	- .503
24949.	0.5702	0.7485	0.6593	6823.	- .503	- .503
25248.	0.5813	0.7563	0.6693	6798.	- .508	- .508
27051.	0.5951	0.7642	0.6797	6810.	- .500	- .500
28015.	0.6081	0.7701	0.6891	6823.	- .499	- .499
28910.	0.6198	0.7854	0.7026	6810.	- .501	- .501
29905.	0.6873	0.7939	0.7406	6810.	- .500	- .500
30165.	0.7191	0.7975	0.7583	6810.	- .500	- .500
30396.	0.7433	0.7999	0.7716	6810.	- .504	- .504
30889.	0.7656	0.8020	0.7838	6835.	- .500	- .500
31962.	0.7733	0.8180	0.7956	6798.	- .503	- .503
32685.	0.7832	0.8326	0.8079	6810.	- .502	- .502
33235.	0.8020	0.8469	0.8244	6810.	- .502	- .502
33611.	0.8143	0.8399	0.8371	6810.	- .502	- .502
34163.	0.8246	0.8730	0.8498	6798.	- .504	- .504
34713.	0.8266	0.8890	0.8578	6798.	- .503	- .503
35366.	0.8316	0.9096	0.8706	6810.	- .504	- .504
35915.	0.8321	0.9320	0.8820	6810.	- .502	- .502
36498.	0.8246	0.9327	0.8887	6810.	- .502	- .502
37116.	0.8215	0.9634	0.8924	6823.	- .501	- .501
37633.	0.8368	0.9783	0.9076	6798.	- .509	- .509
38336.	0.8539	0.9822	0.9181	6823.	- .501	- .501

TABLE 5-65. CRACK GROWTH DATA SPECIMEN GT160KAB49-35 S/N 4

CYCLE #	CRACK LENGTH (INS)			MAX. STRESS (PSI)	STRESS RATIO
	LEFT	RIGHT	AVERAGE		
306.	0.2402	0.2495	0.2449	0.	0.0
1816.	0.2597	0.2490	0.2543	11868.	-506
3252.	0.2762	0.2620	0.2701	11856.	-507
4911.	0.2847	0.2864	0.2855	11856.	-508
6483.	0.2865	0.3102	0.2984	11868.	-507
7436.	0.2864	0.3340	0.3112	11856.	-505
8334.	0.2988	0.3564	0.3276	11868.	-506
9039.	0.2925	0.3623	0.3274	11856.	-506
10006.	0.2944	0.4066	0.3505	11856.	-506
11305.	0.2995	0.4303	0.3650	11868.	-507
12722.	0.3055	0.4543	0.3799	11868.	-507
13924.	0.3194	0.4767	0.3980	11868.	-507
14975.	0.3277	0.5025	0.4151	11856.	-507
15727.	0.3351	0.5263	0.4307	11856.	-507
16602.	0.3402	0.5501	0.4452	11880.	-505
17365.	0.3476	0.5751	0.4613	11856.	-506
18197.	0.3573	0.5896	0.4736	11868.	-507
18817.	0.3702	0.6137	0.4920	11856.	-506
19737.	0.3846	0.6329	0.5088	11856.	-506
20726.	0.4040	0.6494	0.5267	11868.	-507
20600.	0.4234	0.6636	0.5435	11856.	-506
20870.	0.4322	0.6874	0.5598	11868.	-505
21144.	0.4415	0.7112	0.5764	11868.	-505
21345.	0.4595	0.7350	0.5973	11856.	-505
21498.	0.4790	0.7509	0.6149	11868.	-506
21753.	0.4964	0.7657	0.6320	11868.	-508
22243.	0.4882	0.7895	0.6389	11856.	-506
22368.	0.5012	0.8031	0.6521	11856.	-506
22611.	0.5150	0.8298	0.6724	11856.	-505
22685.	0.5345	0.8400	0.6672	11856.	-506
22771.	0.5539	0.8490	0.7015	11856.	-506
22810.	0.5604	0.8757	0.7180	11856.	-506
22932.	0.5710	0.8950	0.7330	11856.	-506
23001.	0.5909	0.9069	0.7489	11856.	-509
23041.	0.6029	0.9318	0.7674	11856.	-506
23088.	0.6090	0.9948	0.8019	11856.	-505
23190.	0.6034	1.0186	0.8110	11856.	-507
23289.	0.6043	1.0224	0.8134	11843.	-507
23327.	0.9009	1.1638	1.0323	296.	-097

6.0 SINGLE-SHEAR LAP-JOINT TEST PROGRAM

The purpose of the single-shear lap-joint test program was to assess the capabilities of the state-of-the-art analytical methods to predict crack growth life of structural joints typical of those utilized in airframe structure.

6.1 TEST SPECIMENS

A total of eighteen (18) single-shear lap-joint specimens were tested. The specimens were made of 2024-T3XX and 7075-T6XX aluminum alloys to represent material used in lower skin Fighter/Trainer and Bomber/Cargo type aircraft, respectively. The specimens contained split skin joint spliced by a plate through two rows of fasteners at each side. The specimens configuration is shown in Figures 6-1 and 6-2 for 2024-T3XX and 7075-T6XX aluminum alloys respectively.

The specimens were pre-cracked prior to assembly. The initial flaw was induced by means of a saw-cut followed by the application of constant amplitude loading not exceeding 40% of the yield stress. The loading was applied until a corner flaw of 0.050 in. was achieved. The initial flaw was located at the edge of the center fastener hole in the second row of fasteners. The testing included three types of specimen. They included the following configuration:

- a. The base line was no interference, clamp-up or sealant.
- b. Clamp-up and interference fit only.
- c. Clamp-up, interference fit and sealant.

6.2 TEST DESCRIPTION

The testing was performed using a hydraulic, computer controlled MTS machine. Anti-buckling plates were installed on both sides of the specimens to prevent lateral instability during compressive loading. The testing was performed in a lab-air controlled environment. The loading frequency was approximately 3 Hz. The precracking as well as the testing was performed at the University of Dayton Research Lab, located in Dayton Ohio.

During the test, measurements of crack growth were made by means of visual aid. A record of the crack length is provided for each specimen. At the completion of each test, fractographic examinations were made to evaluate the extent of cracking. Drawings of the fracture surface cross section, are provided in this report.

6.3 LOADING SPECTRA

The specimens were subjected to three loading spectra:

- a. Constant amplitude loading spectrum.
- b. A-10A flight-by-flight loading spectrum.
- c. AMAVS flight-by-flight loading spectrum.

The 'A-10A' and the 'AMAVS' loading spectra contained marker band cycles. The description of the loading spectra may be found in Volume III of the report. The loading configurations for the various specimens are shown in Table 6-1.

6.4 TEST RESULTS

The test results of eighteen (18) single-shear lap-joint specimens are summarized in Table 6-1 and shown individually in Figures 6-8 through 6-25. For the majority of the specimens, the number of cycles to failure was consistent for similar specimen except specimens LJ-25 and LJ-26 which had a scatter factor of 2.0. These specimens were subjected to AMAVS loading spectrum and represented Group A of the testing. The low cycles to failure for specimen LJ-25 compared to LJ-26 may be attributed to the size of the initial flaw existing in LJ-25 prior to testing. The short life to failure for specimens LJ-3 through LJ-30 was caused by the relatively high applied loads which were close to the yield point of the material. The strain survey which was performed on specimen LJ-1 (Table 6-2) shows a fairly expected increase in stress level, on the order of 30% as the crack approaches the critical length. Subsequent to failure, the fracture surface of each specimen was examined using a low-power magnifying glass (Figure 6-1 through 6-18). The majority of the specimens show substantial cracking prior to failure with the exception of specimens LJ-27 through LJ-30. These specimens were made of 7075-T6XX aluminum alloys

and were subjected to the AMAVS loading spectrum. The net stress level for these specimens was 50.3 Ksi (extremely high for 70/5-T6XX material) which caused early failure.

6.5 FRACTOGRAPHIC ANALYSIS

Five (5) specimens were selected for fractographic examination under a high-power microscope. Specimens No.'s LJ-1, LJ-6, LJ-7, LJ-10 and LJ-25 were those selected for development of information on the initiation and growth of cracks (Figures 6-3 through 6-7). Marker band positions were also investigated on specimens No. LJ-7 and LJ-25, which were subjected to A-10A and AMAVS loading spectrum, respectively. In both cases some marker band striations were clearly visible. Also the initiation of secondary flaws occurred in adjacent holes, with the exception of specimen LJ-10 which had initiation at the faying surface. This may be attributed to a high degree of fastener clamp-up and the presence of sealant at the faying surface which could cause high load transfer through surface friction. Crack starter flaws can be seen in most fracture faces, except where compressive loads have caused local damage. In most of the specimens, additional independent cracks have initiated in other holes. The presence of multiple holes with multiple cracks makes uncertain the determination of a clearly defined a_{cr} since the segments of the cross section will tend to fail independently and sometimes sequentially.

The results of the examination are presented as diagrams of the physical cross section showing origin directions and the extent of crack growth. Selected comments are appended appropriate to each specimen followed by photos. Crack lengths can be directly derived from the diagrams and photos of marker bands, as well as the beginnings of fast fracture.

All diagrams are viewed with the joint nuts on the upper side. Growth in the plane strain (flat) mode, in the plane stress (slant) mode and rapid fracture are separated in the diagrams.

TABLE 6-1. SINGLE-SHEAR LAP-JOINT SPECIMENS SUMMARY TABLE

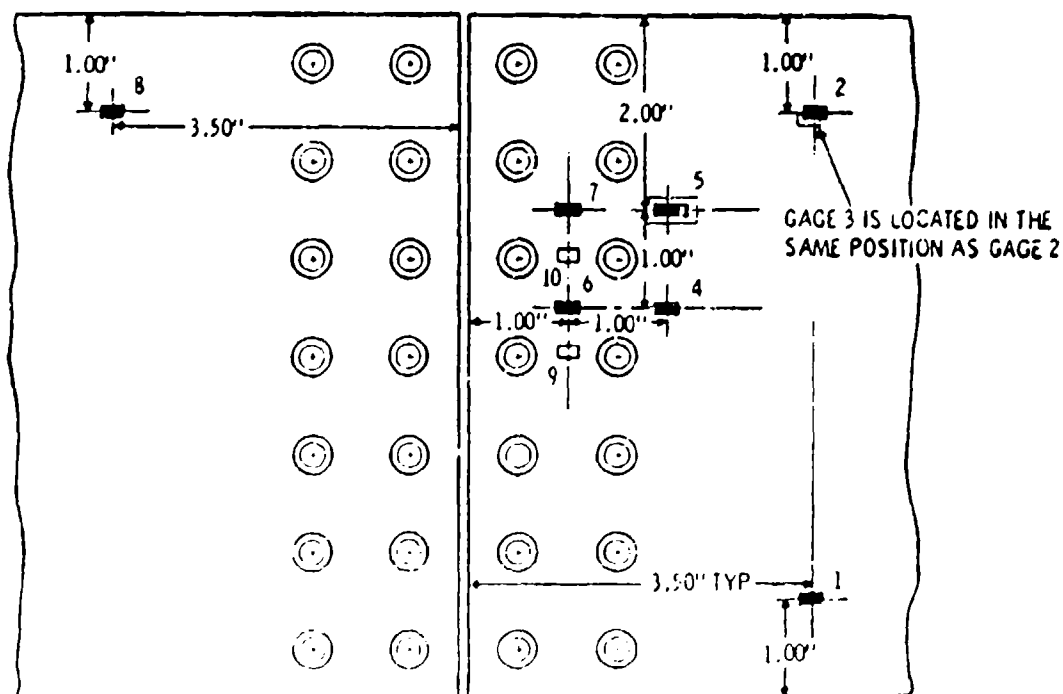
MATERIAL	SPECIMEN ID	TEST CONDITION	TYPE OF LOADING	GROSS STRESS (Ksi)	*CYCLES TO FAILURE
2024-T3	LJ 1 LJ 2	Clearance fit, no clamp-up, no sealant	Constant amplitude	17.0 max. 6.1 min.	44,200 46,300
	LJ 5 LJ 6	Interference fit, clamp-up, no sealant	Constant amplitude	17.0 max. 6.1 min.	94,700 98,700
	LJ 9 LJ 10	Interference fit, clamp-up sealant	Constant amplitude	17.0 max. 6.1 min.	69,910 88,300
	LJ 3 LJ 4	Clearance fit, no clamp-up, no sealant	A-10A spectrum	37.75 max.	42,086 47,102
	LJ 7 LJ 8	Interference fit, clamp-up no sealant	A-10A spectrum	37.75 max.	59,958 59,638
	LJ 11 LJ 12	Interference fit, clamp-up, sealant	A-10A spectrum	37.75 max.	41,037 41,693
7075-T6	LJ 25 LJ 26	Clearance fit, no clamp-up, no sealant	AMAVS spectrum	37.75 max.	3,559 7,215
	LJ 27 LJ 28	Interference fit, clamp-up, no sealant	AMAVS spectrum	37.75 max.	11,091 11,119
	LJ 29 LJ 30	Interference fit, clamp-up, sealant	AMAVS spectrum	37.75 max.	11,091 8,870

*1 life time of A-10 Spectrum = 185,400 cycles

1 life time of AMAVS Spectrum = 143,900 cycles

TABLE 6-2. STRAIN SURVEY DATA SPECIMEN LJ-1 ($\mu\epsilon$)
GROSS AREA = 1.316 IN²

LOAD (LBS)	CYCLES LAPSED	GAGE NO.										CRACK LENGTH (IN)
		1	2	3	4	5	6	7	8	9	10	
0	0			0	-1	-1	-1	-1	-2	-2	0	
22400	0	1786	1658	1374	674	612	849	886	1797	139	165	
0	0	-73	-73	71	-63	-59	-17	-16	-3	-11	-17	
15200	39800	1222	1146	1114	163	1124	126	1137	1090	146	276	
22400	39800	1859	1828	1525	291	1606	212	1625	1860	208	378	
22400	40800	1884	1852	1534	319	1727	231	1755	1858	188	377	
22400	41700	1921	1891	1547	360	1886	248	1926	1854	196	349	
22400	42400	1968	1937	1564	403	2047	263	2090	1848	216	314	0.345
22400	42800	2028	1994	1591	442	2189	270	2233	1844	245	285	0.404
22400	43700	2289	2223	1725	537	1666	254	1769	1811	210	192	4.08
22400	43900	2386	2252	1757	557	672	254	697	1765	218	141	4.153
22400	44000	2517	2341	1779	602	593	276	498	1771	267	135	
22400	44200	2659	2388	1768	666	638	277	409	1736	275	144	
0	44200	-37	-49	2	-41	-106	-36	-56	-100	179	144	



GAGES LOCATION

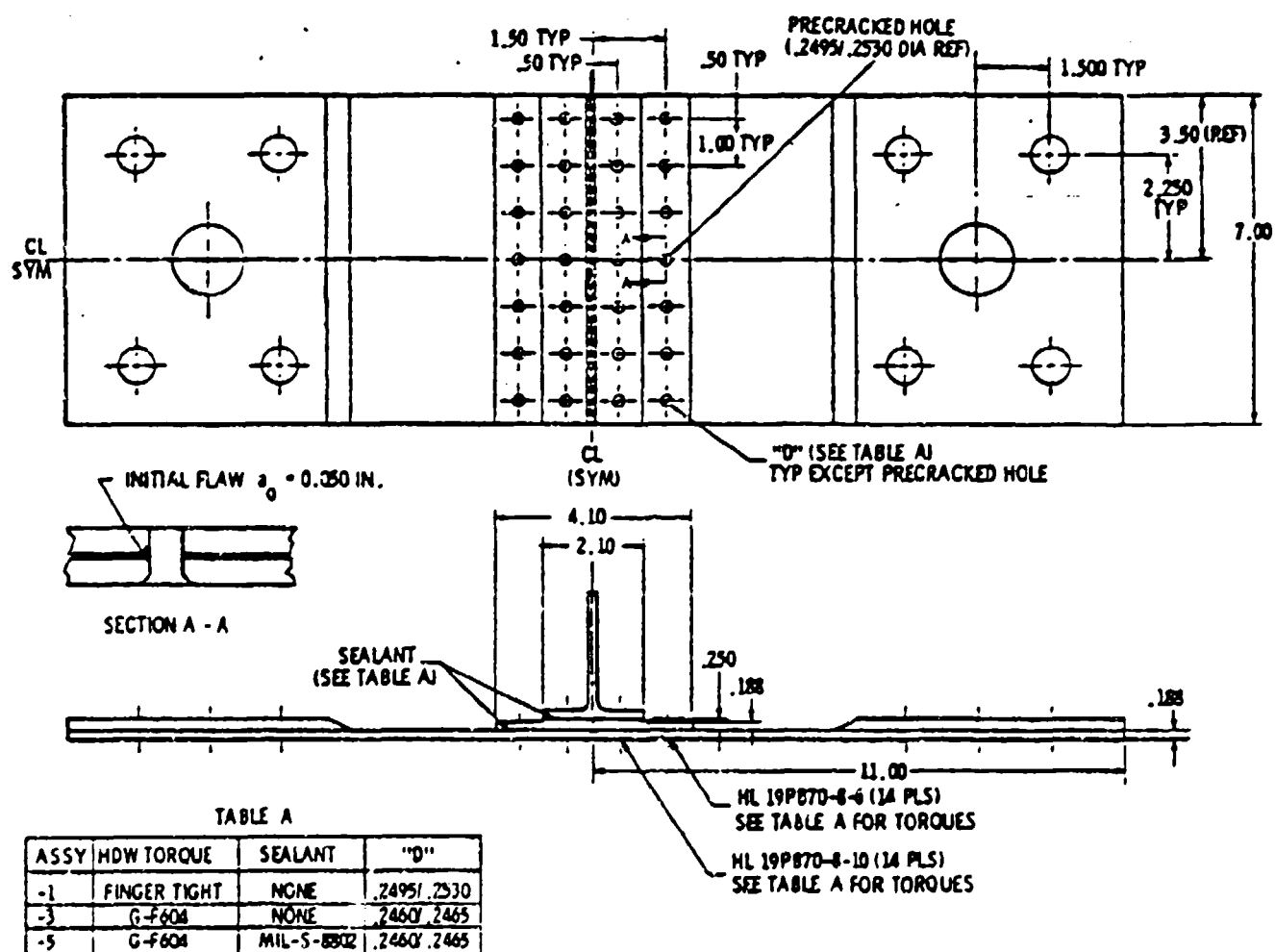


Figure 6-1. Single-Shear Lap-Joint Specimen Configuration Subjected to A-10 or Constant Amplitude Loading Spectrum

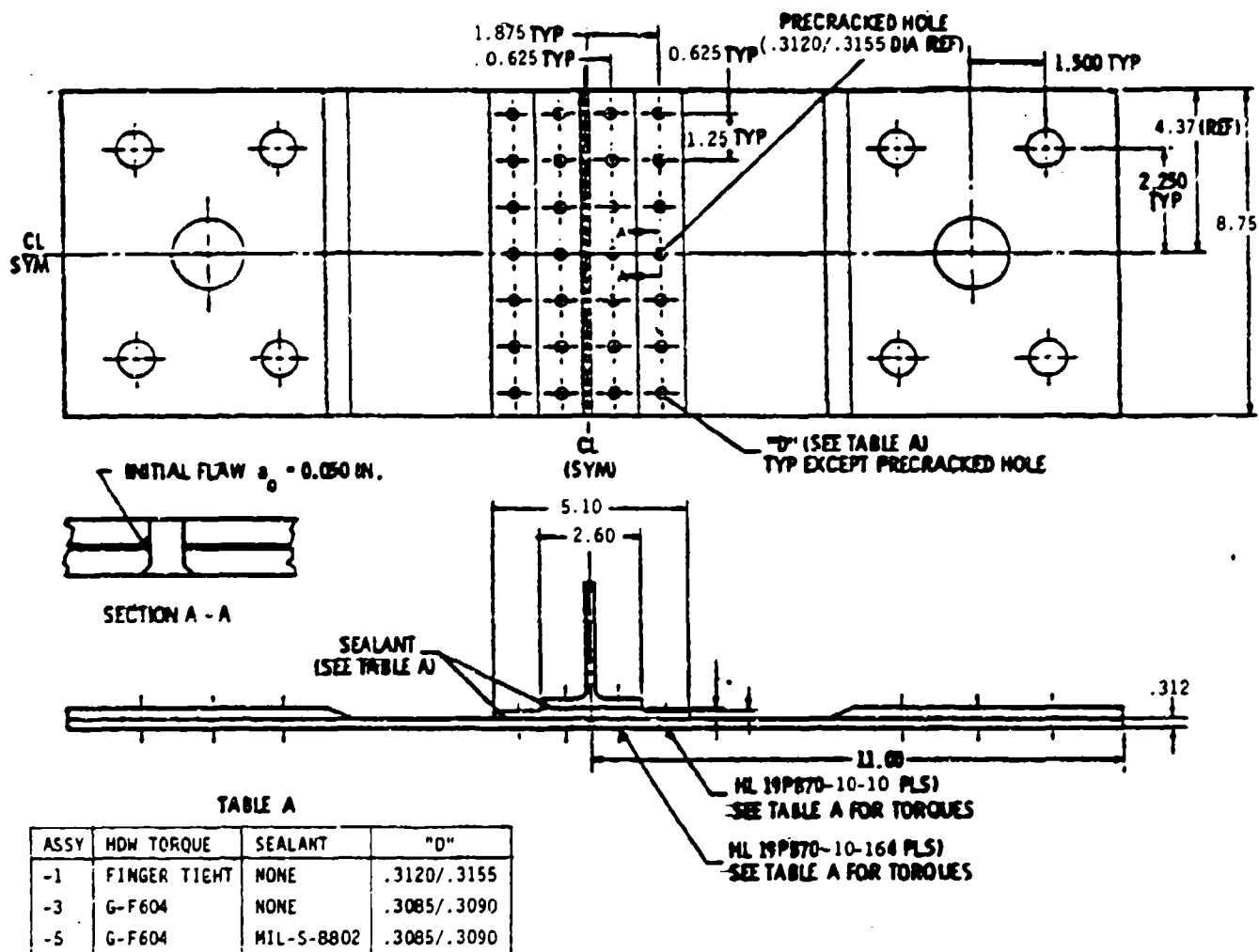


Figure 6-2. Single-Shear Lap-Joint Specimen Configuration Subjected to AMAVS Loading Spectrum

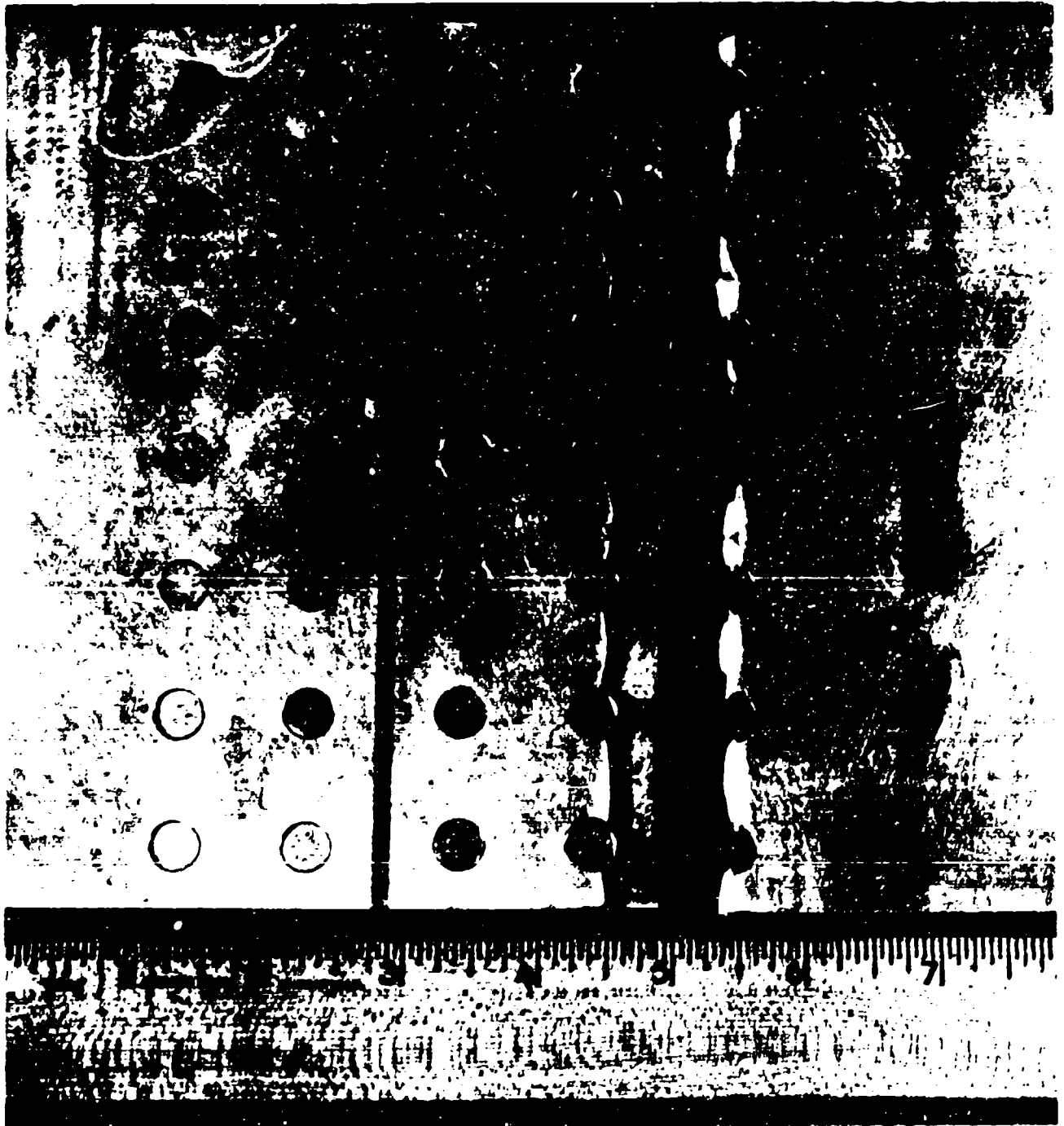





Figure 6-3. Single-Shear Lap-Joint Specimen Subsequent to Failure

SPECIMEN LJ-1

DIAGRAM KEY:

-  FLAT, PLANE STRAIN MODE
-  SLANT, PLANE STRESS MODE
-  RAPID FRACTURE

NOTES: NO UNUSUAL CONDITIONS

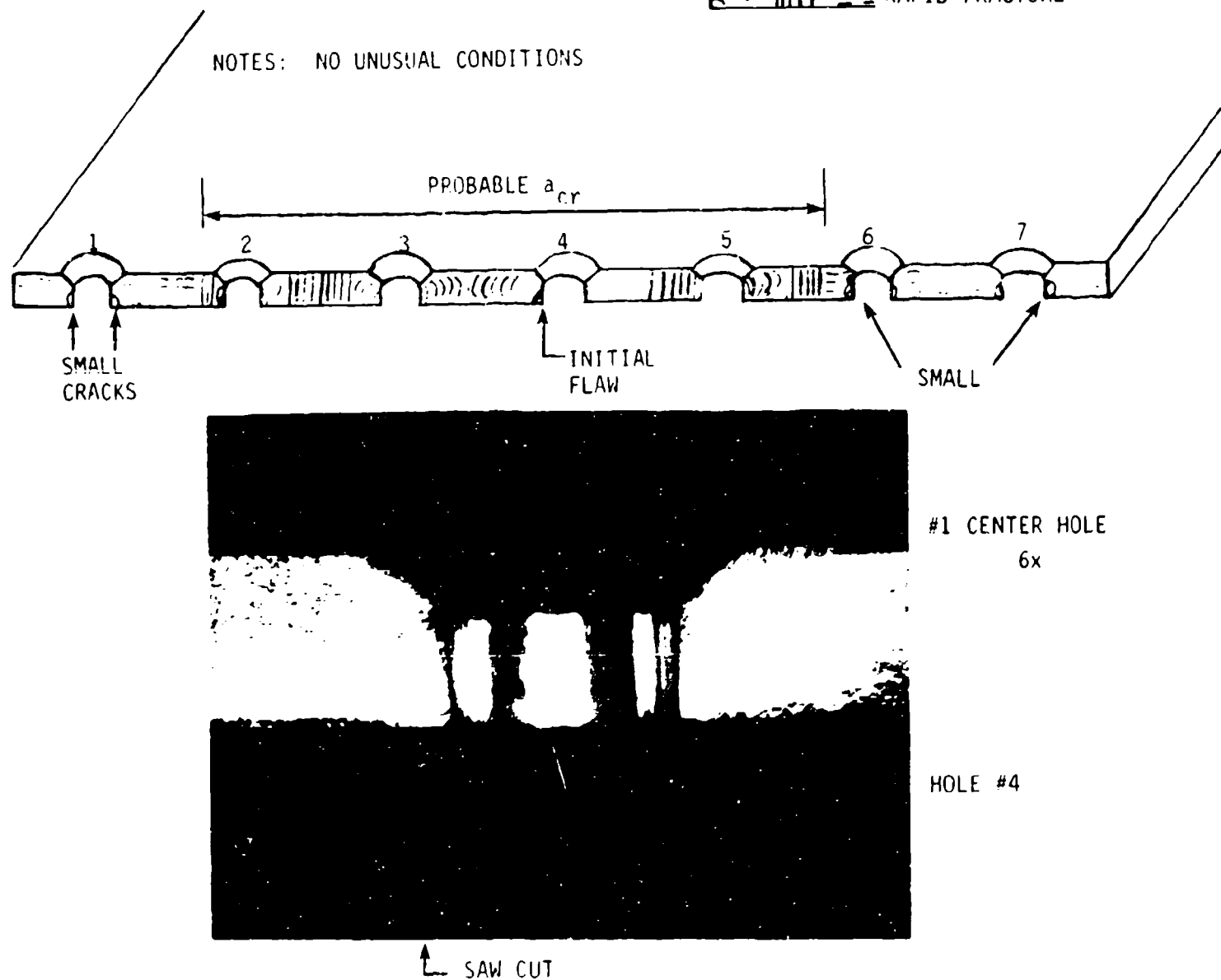





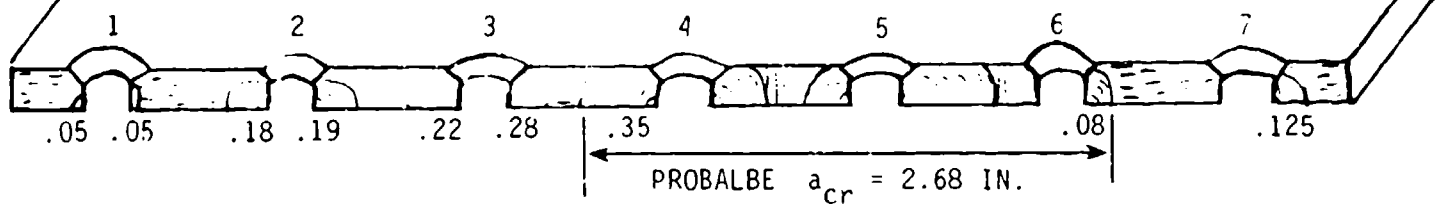
Figure 6-4. Fractographic Examination Specimen LJ-1

SPECIMEN
LJ-6
(SINGLE SHEAR)

KEY:

-  FLAT, PLANE STRAIN MODE
-  SLANT, PLANE STRESS MODE
-  RAPID FRACTURE

- NOTES:
1. VERY POOR QUALITY HOLES
 2. CRACK FACES FRETTED-INDICATING COMPRESSION LOADS
 3. CAN NOT DISCERN STARTER FALW DUE TO CRACK FACE FRETTING
 4. PLATE SURFACES AROUND SOME HOLES ARE HEAVILY FRETTED
 5. MOST INITIATION SITES ARE CAUSED BY FRETTING OFF THE HOLE CENTERS





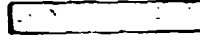
HOLE NO. 4

CRACK FACE FRETTING

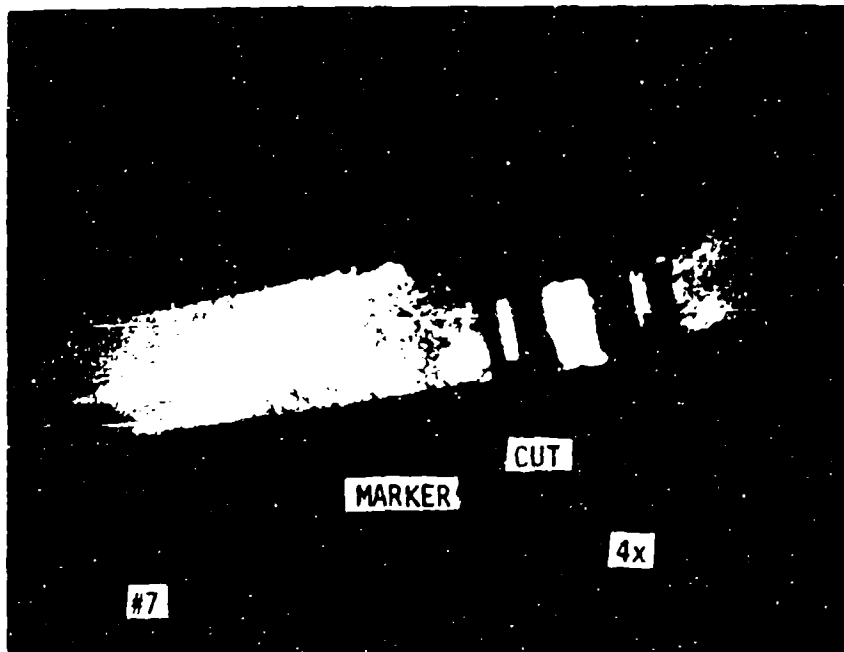
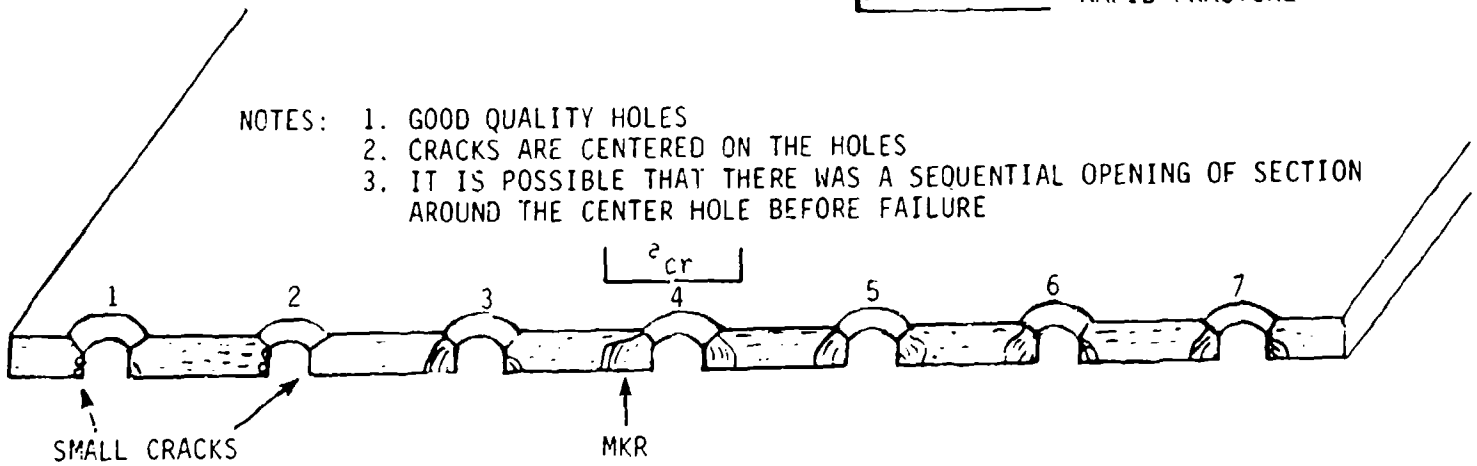
Figure 6-5. Fractographic Examination Specimen LJ-6

SPECIMEN LJ-7

KEY:

	FLAT, PLANE STRAIN MODE
	SLANT, PLANE STRESS MODE
	RAPID FRACTURE

- NOTES:
1. GOOD QUALITY HOLES
 2. CRACKS ARE CENTERED ON THE HOLES
 3. IT IS POSSIBLE THAT THERE WAS A SEQUENTIAL OPENING OF SECTION AROUND THE CENTER HOLE BEFORE FAILURE






HOLE NO. 4

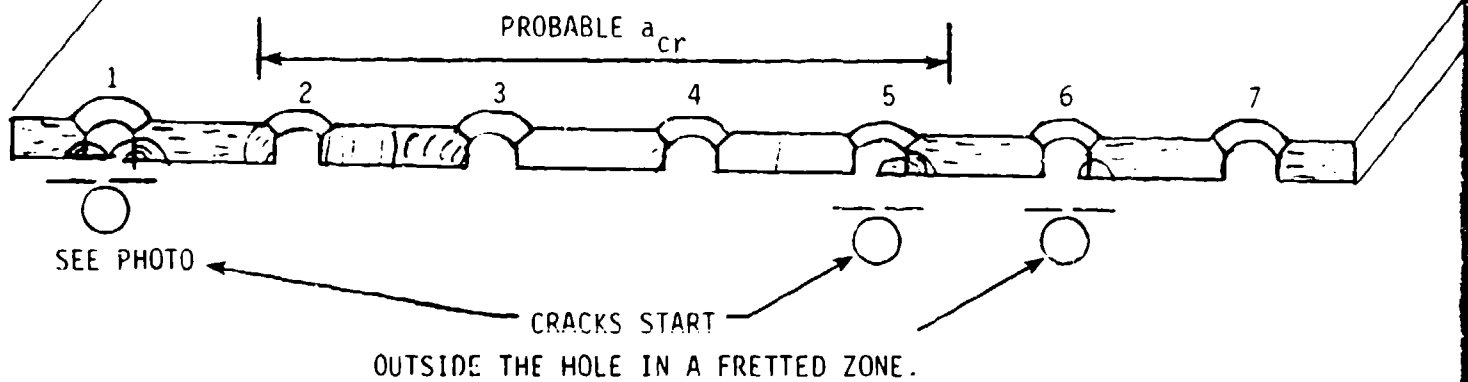
Figure 6-6. Fractographic Examination Specimen LJ-7

SPECIMEN LJ-10

KEY:

-  FLAT, PLANE STRAIN MODE
-  SLANT, PLANE STRESS MOD
-  RAPID FRACTURE

NOTES: 1. FRETTING ON THE MATING SURFACES AROUND HOLES LEADS TO CRACK INITIATION AWAY FROM HOLE. SEE PHOTO.

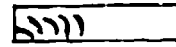


HOLE NO. 1

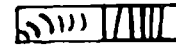
Figure 6-7. Fractographic Examination Specimen LJ-10

SPECIMEN LJ-25

KEY:



FLAT, PLANE STRAIN MODE

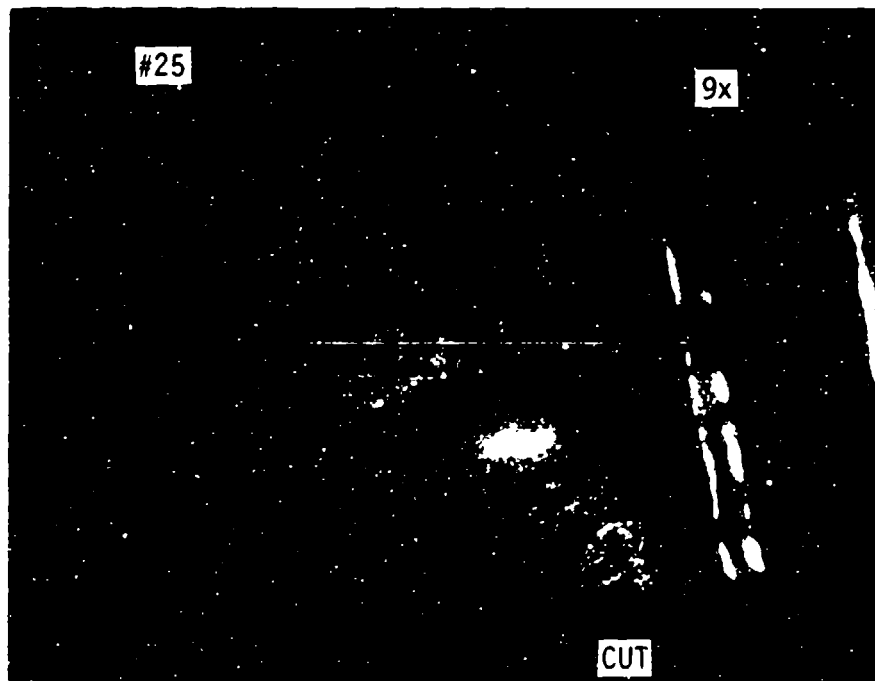
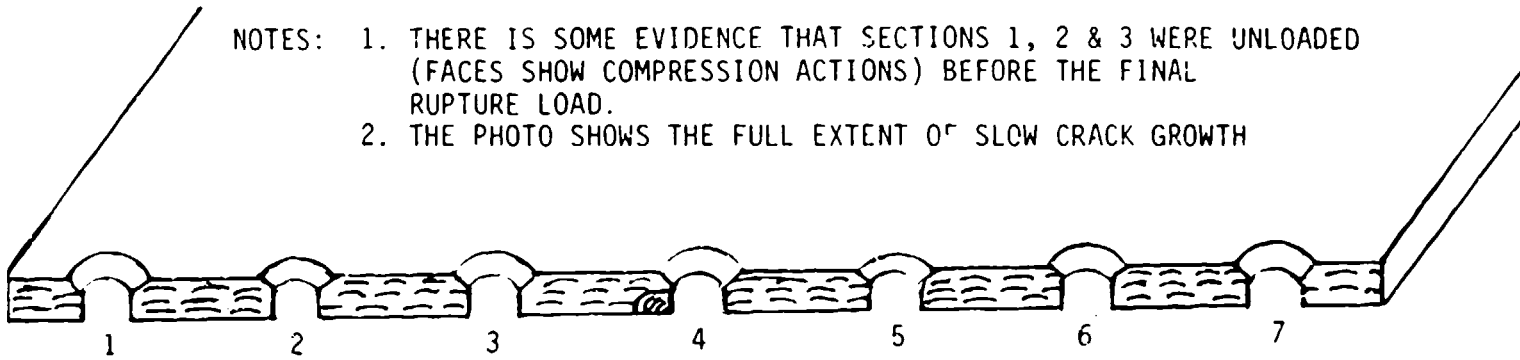


SLANT, PLANE STRESS MODE



RAPID FRACTURE

- NOTES: 1. THERE IS SOME EVIDENCE THAT SECTIONS 1, 2 & 3 WERE UNLOADED
(FACES SHOW COMPRESSION ACTIONS) BEFORE THE FINAL
RUPTURE LOAD.
2. THE PHOTO SHOWS THE FULL EXTENT OF SLOW CRACK GROWTH

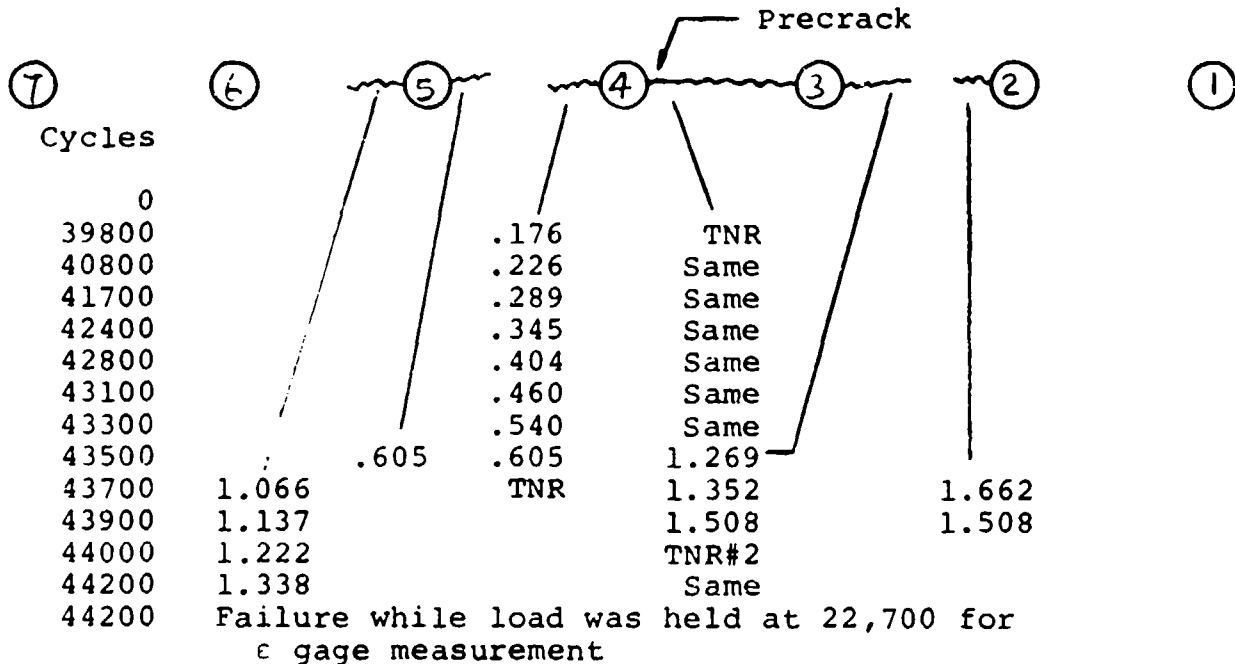


HOLE NO. 4

Figure 6-8. Fractographic Examination Specimen LJ-25

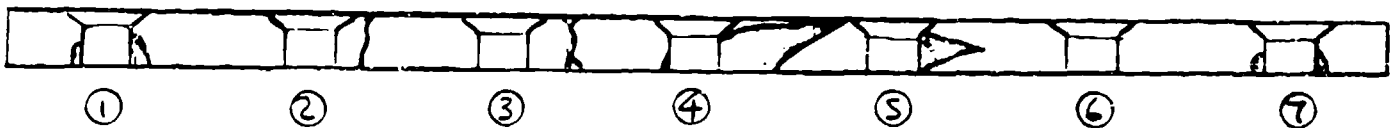
TABLE 6-3. CRACK MEASUREMENTS SPECIMEN LJ-1

SAMPLE NUMBER:	1	CYCLES TO FAILURE:	44,200
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	NA
MAX LOAD (KIPS):	22.4/+8.0	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	CA 3 Hz	HOLE DIAMETER:	0.251



TNR = Through Next Rivet

1. All measurements from left or right edge of precrack hole.



FAILURE SURFACE

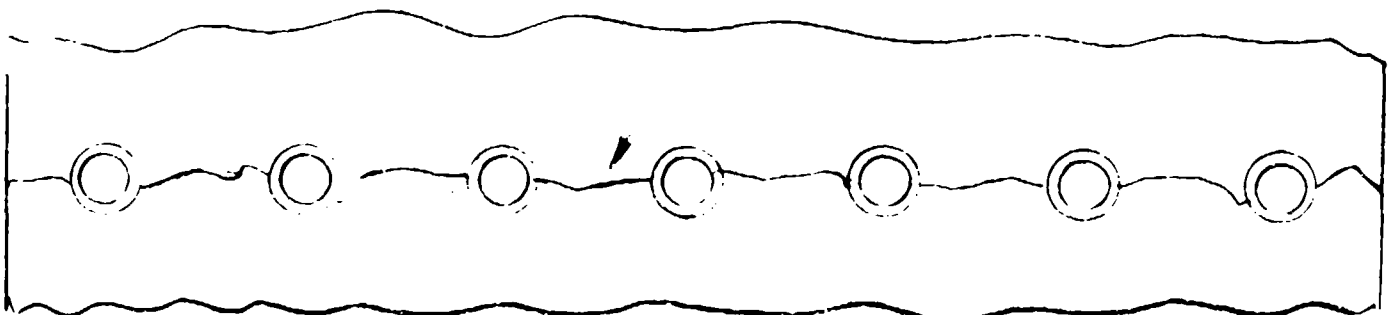
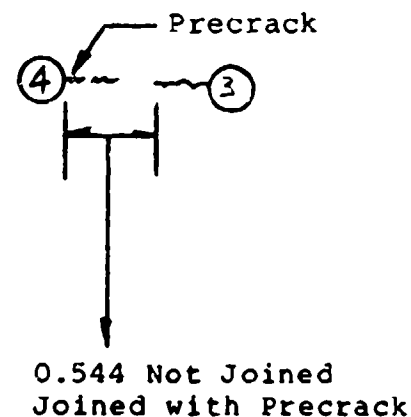


TABLE 6-4. CRACK MEASUREMENTS SPECIMEN LJ-2

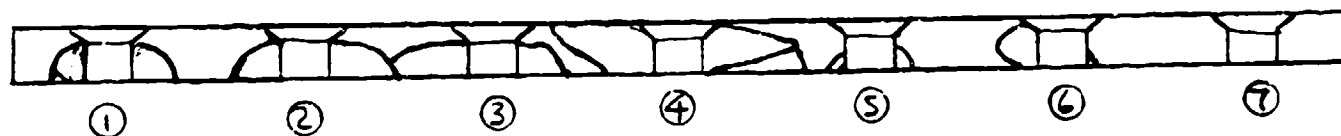
SAMPLE NUMBER:	2	CYCLES TO FAILURE:	46,300
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	NA
MAX LOAD (KIPS):	22.4/+8.0	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	CA 3 Hz	HOLE DIAMETER:	0.250

CYCLES	DISTANCE FROM EDGE OF HOLE	
	FRONT	
	PRE-CRACK LEFT	HOLE RIGHT
0	0.000	0.000
27500	0.000	0.131
30500	0.000	0.184
33600	0.000	0.240
36100	0.000	0.293
39400	0.000	0.359
40600	0.000	0.489
42500	0.080	0.544
43400	0.147	TNR
44100	0.197	Same
45500	0.287	1.274
46100	0.353	1.401
46300	Failure	Failure



No other cracks. Only the skin with the precrack grew.

TNR = Through Next Rivet



FAILURE SURFACE

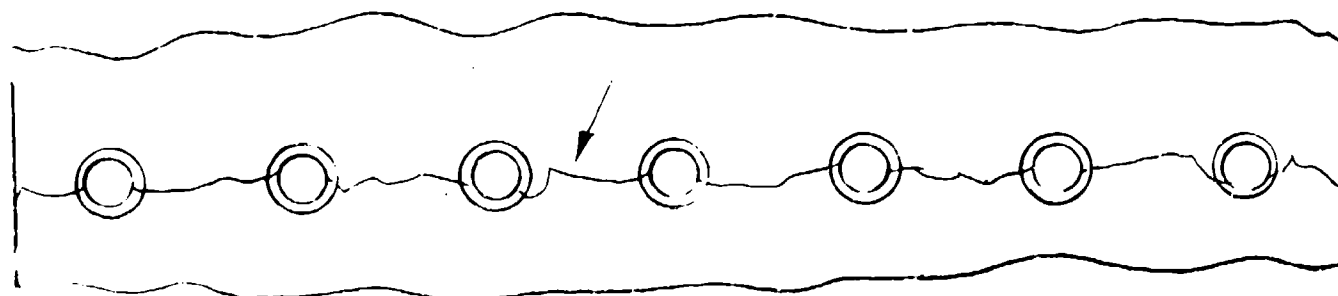


TABLE 6-5. CRACK MEASUREMENTS SPECIMEN LJ-3

SAMPLE NUMBER:	3	CYCLES TO FAILURE:	42,086
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	21.4
MAX LOAD (KIPS):	49.7	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 3 Hz	HOLE DIAMETER:	0.248

1. No crack growth data.
2. Failure at 42,086 cycles = 21.4% of life.
3. Failure was not at rivet line which had precrack hole.
4. Plastic zone at crack tip visible at 37,530 cycles but crack not visible.

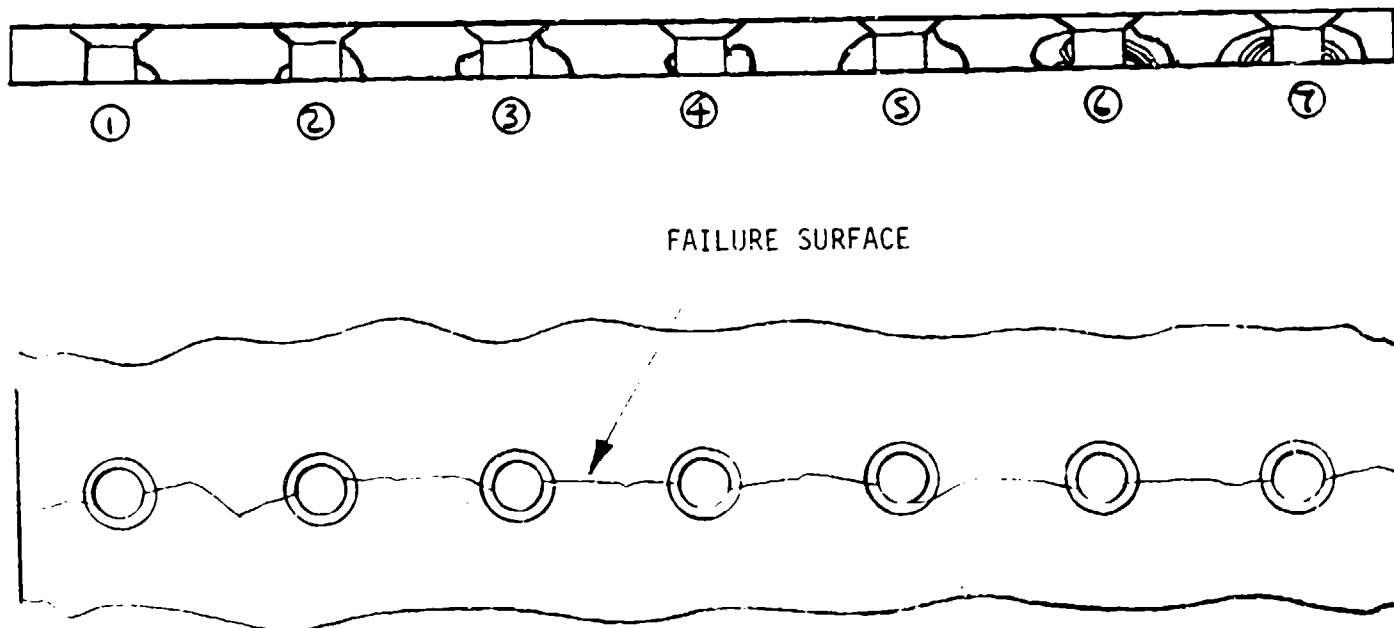
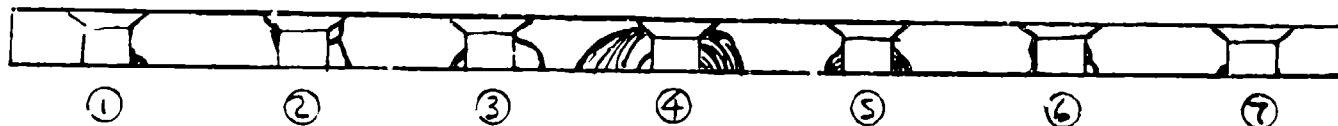


TABLE 6-6. CRACK MEASUREMENTS SPECIMEN LJ-4

SAMPLE NUMBER:	4	CYCLES TO FAILURE:	47,102
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	NA
MAX LOAD (KIPS):	49.7	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 3 Hz	HOLE DIAMETER:	0.252

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE FRONT	
		PRE-CRACK HOLE LEFT	HOLE RIGHT
0	0	0.000	0.000
5	20	0.000	0.097
5.36	21.43	0.000	0.187
5.99	23.95	Failure	Failure



FAILURE SURFACE

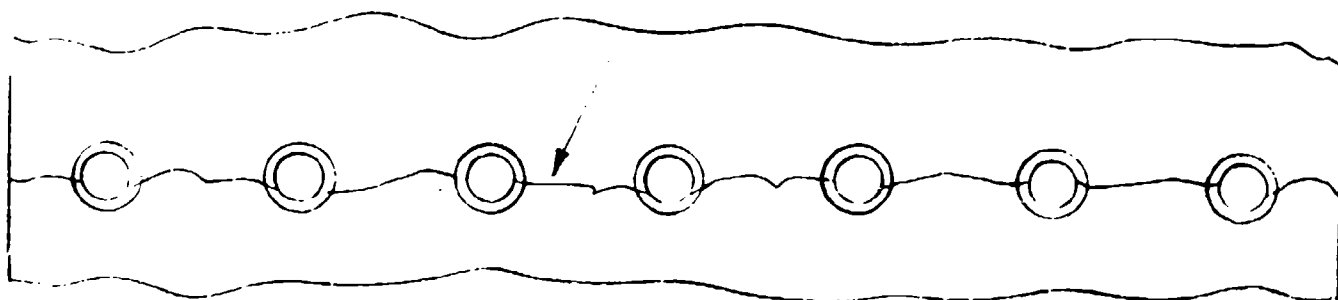
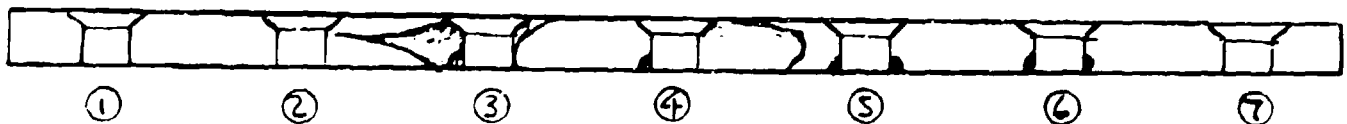


TABLE 6-7. CRACK MEASUREMENTS SPECIMEN LJ-5

SAMPLE NUMBER:	5	CYCLES TO FAILURE:	94,700
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	NA
MAX LOAD (KIPS):	22.4/+8.0	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	CA 3 Hz	HOLE DIAMETER:	0.255

		DISTANCE FROM EDGE OF HOLE FRONT	
		PRE-CRACK HOLE	
		LEFT	RIGHT
	CYCLES		
	0	0.000	0.000
	35500	0.000	0.000
	42200	0.000	0.085
	48900	0.000	0.179
	57800	0.000	0.283
	65300	0.000	0.384
	70600	0.000	0.482
	75500	0.000	0.586
	76900	0.000	0.682
	83900	0.129	TNR
	86100	0.221	Same
	88900	0.315	Same
	90800	0.409	Same
	92000	0.635	1.252
	92400	TNR	1.340
	93000	Same	1.449
	93500	Same	1.551
	93800	Same	1.646
	94000	1.193	1.742
	94300	1.298	TNR#2
TIP TO TIP	94500	1.404	Same
4 1/4"	94600	1503	Same
	94700	TNR#2	Same
	947++	Failure	Failure



TNR = Through Next Rivet

FAILURE SURFACE

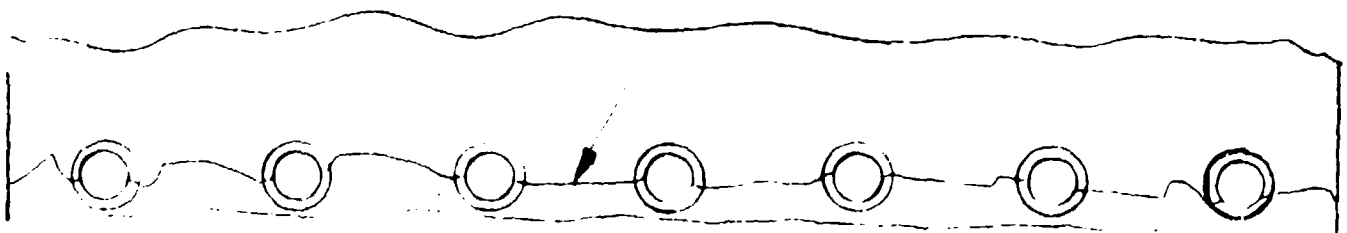


TABLE 6-8. CRACK MEASUREMENTS SPECIMEN LJ-6

SAMPLE NUMBER:	6	CYCLES TO FAILURE:	98,700***
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	NA
MAX LOAD (KIPS):	22.4/+8.0	FINAL CRACK LENGTH	
SPECTRUM TYPE:	CA 3 Hz	HOLE DIAMETER:	0.250

CYCLES	DISTANCE FROM EDGE OF HOLE	
	FRONT	
	PRE-CRACK HOLE	
	LEFT	RIGHT
0	0.000	0
39500	0.000	0.123
48700	0.000	0.241
53500	0.000	0.301
57000	0.000	0.353
61400	0.000	0.404
63800	0.000	0.473
66300	0.000	0.535
67800	0.000	0.585
69100	0.000	TNR
93600	0.000	1.077
95900	0.000	1.170
97800	0.000	1.264
98600	0.000	1.410

*** Failure at rivet row without Precrack

TNR = Through Next Rivet

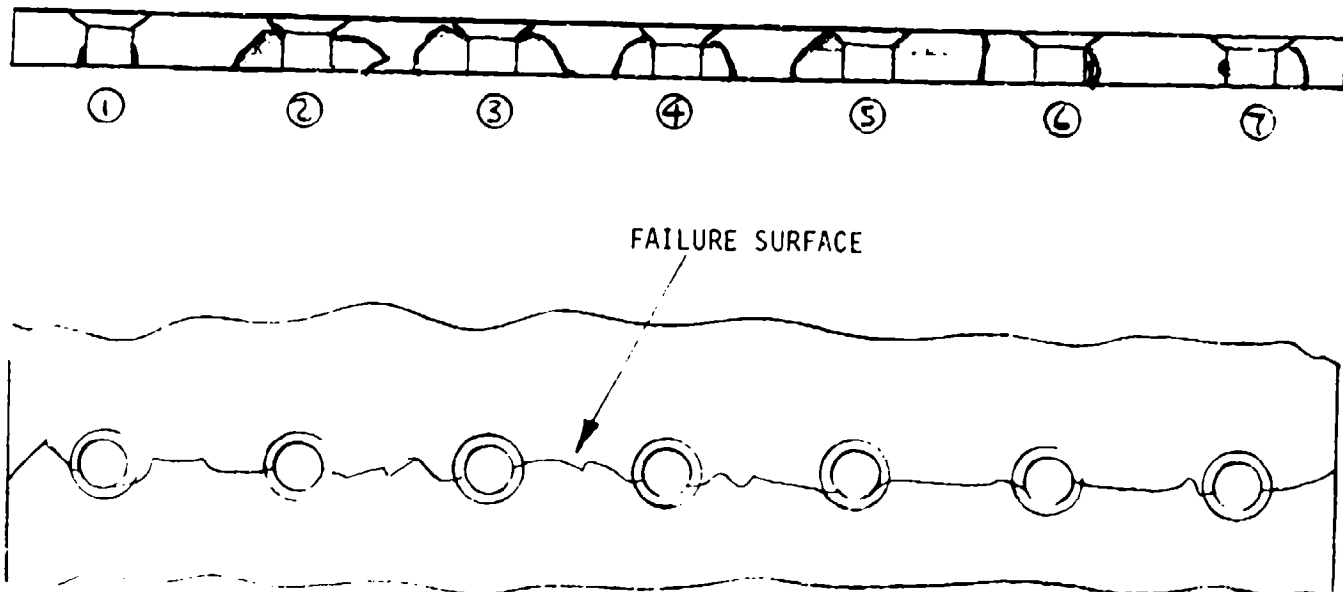


TABLE 6-9. CRACK MEASUREMENTS SPECIMEN LJ-7

SAMPLE NUMBER:	7	CYCLES TO FAILURE:	59,598
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	30.9
MAX LOAD (KIPS):	49.7	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 3 Hz	HOLE DIAMETER:	0.252

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE	
		FRONT	
		PRE-CRACK LEFT	HOLE RIGHT
0	0	0.000	0.000
1	4	0.000	0.000
2	8	0.000	0.000
3	12	0.000	0.000
4	16	0.000	0.000
5	20	0.000	0.000
6	24	0.000	0.000
7	28	0.000	0.081
7.74	30.94	Failure	Failure

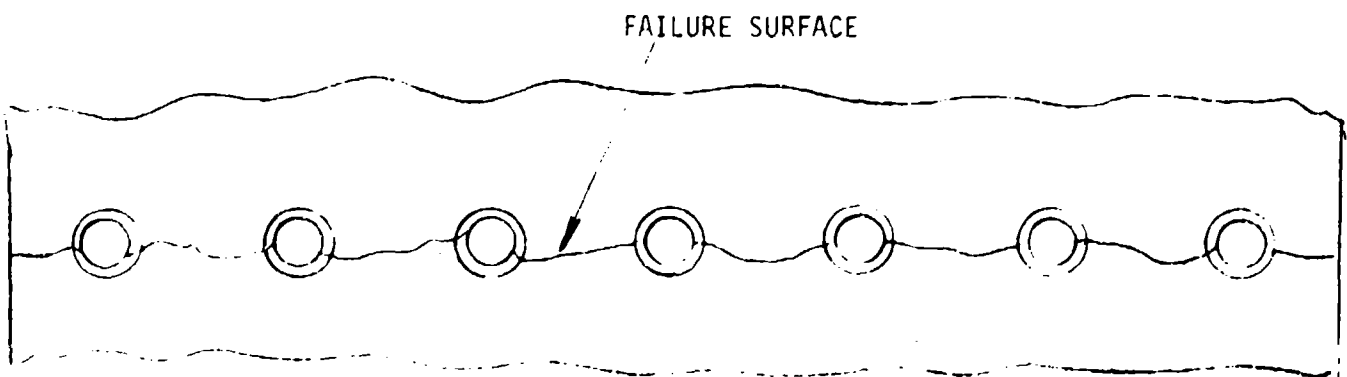
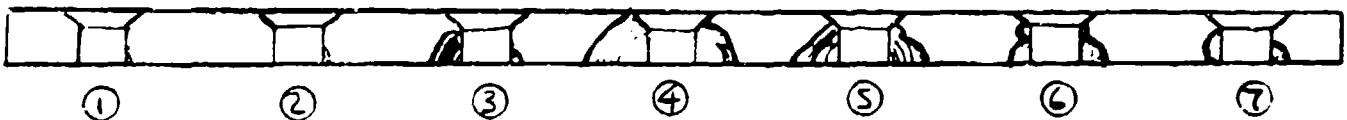
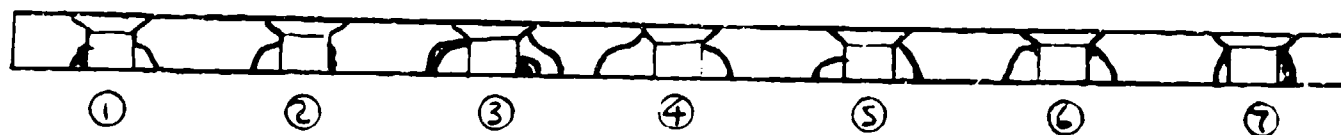


TABLE 6-10. CRACK MEASUREMENTS SPECIMEN LJ-8

SAMPLE NUMBER:	8	CYCLES TO FAILURE:	59,638
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	30.8
MAX LOAD (KIPS):	49.7	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 4 Hz	HOLE DIAMETER:	

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE	
		FRONT PRE-CRACK HOLE LEFT	RIGHT
7	28	0.000	0.096
7.36	29.44	0.000	0.133
	30.8	Failure	Failure



FAILURE SURFACE

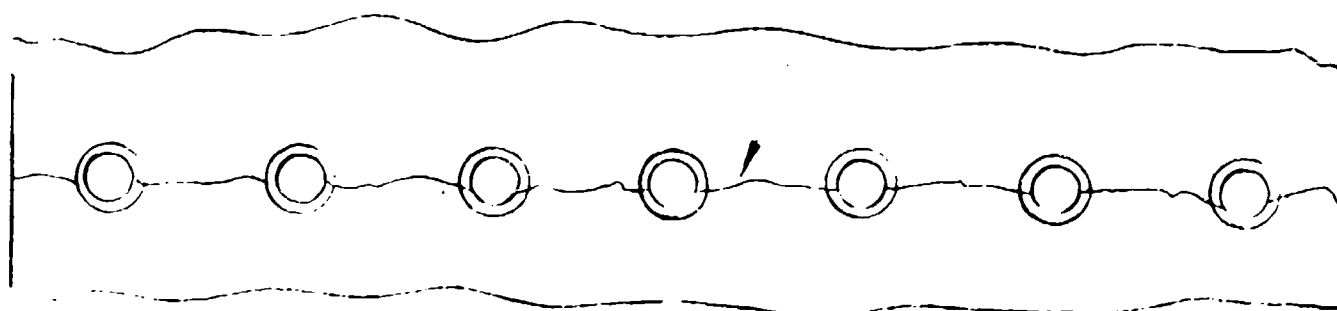


TABLE 6-11. CRACK MEASUREMENTS SPECIMEN LJ-9

SAMPLE NUMBER:	9	CYCLES TO FAILURE:	69,910
SPECIMEN TYPE:	SINGLE LAP JOINT	% O LIFE AT FAILURE:	NA
MAX LOAD (KIPS):	22.4/+8.0	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	CA 3 Hz	HOLE DIAMETER:	0.254

CYCLES	DISTANCE FROM EDGE OF HOLE FRONT		
	PRE-CRACK LEFT	HOLE RIGHT	
0	0.000	0.000	<p>Precrack Next Rivet New Crack</p> <p>0.656 0.640</p>
34300	0.000	0.078	
42100	0.000	0.155	
50600	0.000	0.260	
55300	0.000	0.315	
60400	0.000	0.388	
63100	0.000	0.449	
65000	0.000	0.508	
66000	0.000	0.566	
66700	0.000	0.613	
67700	0.000	0.650	
69800	0.000	TNR	
69800	0.000	1.139	
69890	0.000	1.143	
69910	Failure	Failure	

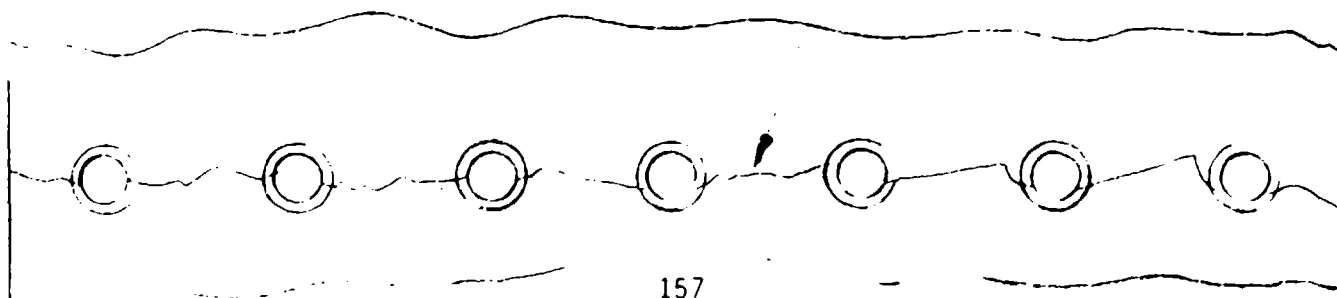
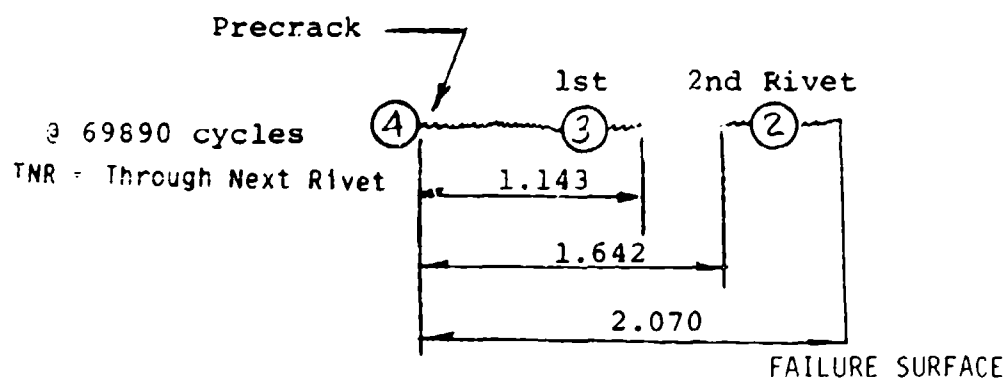
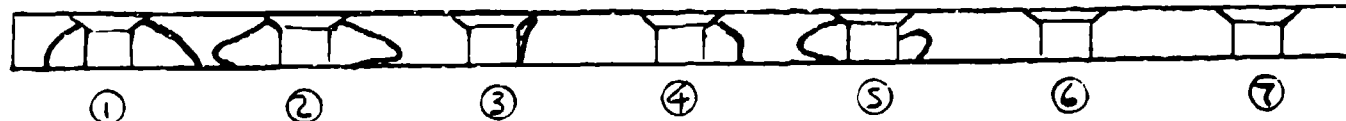
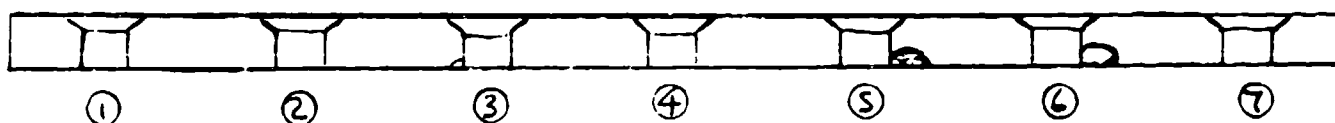


TABLE 6-12. CRACK MEASUREMENTS SPECIMEN LJ-10

SAMPLE NUMBER:	10	CYCLES TO FAILURE:	88,300
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	NA
MAX LOAD (KIPS):	22.4/+8.0	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	CA 3 Hz	HOLE DIAMETER:	0.253

CYCLES	DISTANCE FROM EDGE OF HOLE FRONT	
	PRE-CRACK HOLE	
	LEFT	RIGHT
0	0.000	0
32700	0.000	0.077
35000	0.000	0.114
40000	0.000	0.177
45600	0.000	0.217
54100	0.000	0.317
60400	0.000	0.417
65300	0.000	0.561
66100	0.000	0.615
66600	0.000	TNR
80700	0.000	1.035
82100	0.000	1.149
84000	0.000	1.251
85100	0.000	1.347
86000	0.165	1.485
86300	0.190	1.620
86900	0.303	TNR
37400	0.435	Same
87700	0.536	Same
87800	0.649	Same
87900	TNR	Same
88300	Failure	Failure



TNR = Through Next Rivet

FAILURE SURFACE

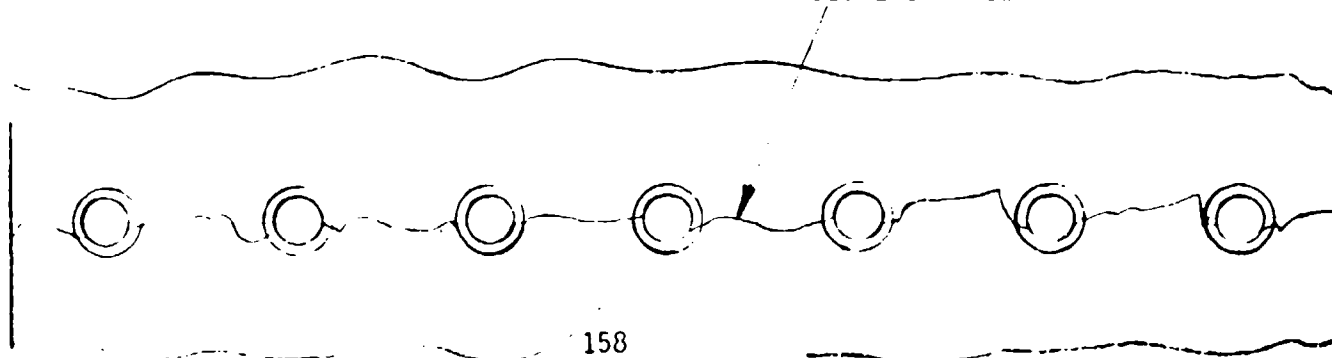


TABLE 6-13. CRACK MEASUREMENTS SPECIMEN LJ-11

SAMPLE NUMBER:	11	CYCLES TO FAILURE:	41,037
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	20.83
MAX LOAD (KIPS):	49.7	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 2 Hz	HOLE DIAMETER:	0.253

1. No visible cracks prior to failure.
2. Failure at 41,037 cycles which is 20.83% of life.

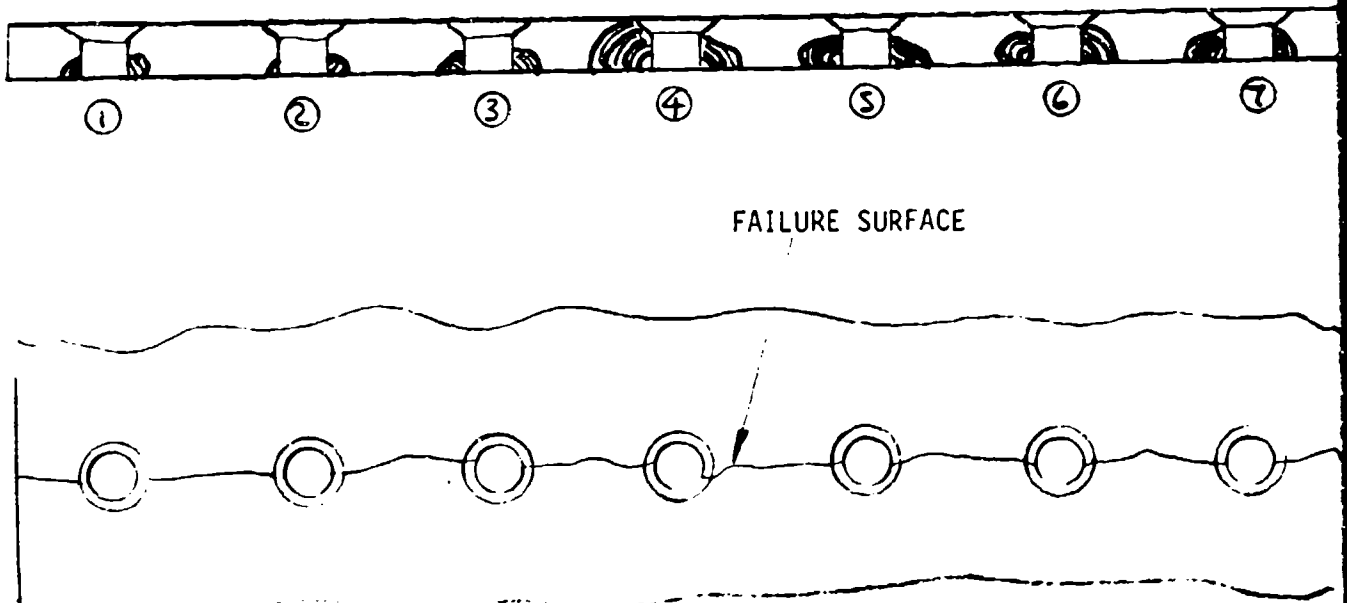
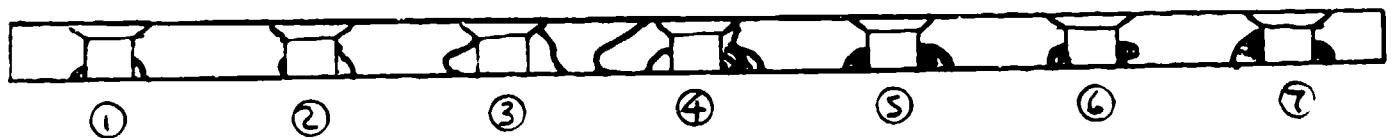


TABLE 6-14. CRACK MEASUREMENTS SPECIMEN LJ-12

SAMPLE NUMBER:	12	CYCLES TO FAILURE:	41,693
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	21.2
MAX LOAD (KIPS):	49.7	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 3 Hz	HOLE DIAMETER:	0.252

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE FRONT	
		PRE-CRACK LEFT	HOLE RIGHT
0	0	0.000	0.000
1	4	0.000	0.000
2	8	0.000	0.000
3	12	0.000	0.000
4	16	0.000	0.000
5	20	0.000	0.322
5.29	21.16	Failure	Failure



FAILURE SURFACE

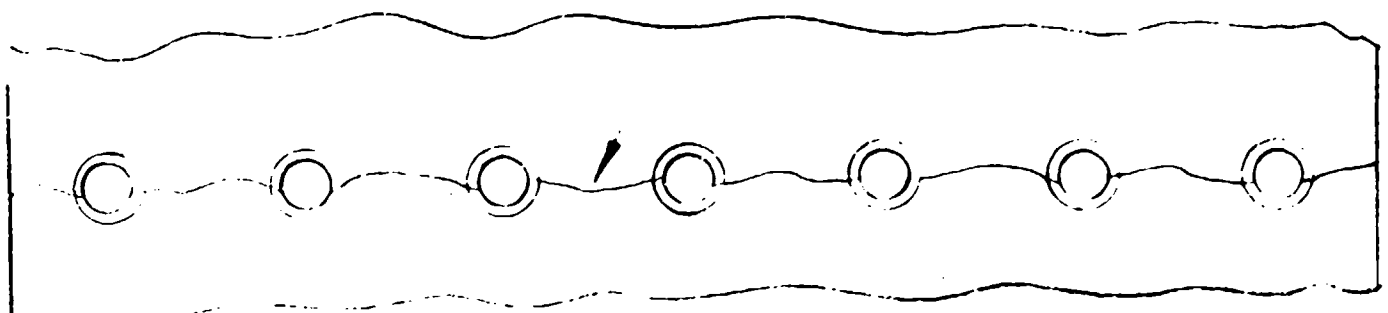


TABLE 6-15. CRACK MEASUREMENTS SPECIMEN LJ-25

SAMPLE NUMBER:	25	CYCLES TO FAILURE:	3,559
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	2.5
MAX LOAD (KIPS):	103.2	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMAVS 1 HZ	HOLE DIAMETER:	0.312

1. At 2,020 cycles the precrack broke through to the next rivet.
2. At 3,127 cycles the left side of the hole with the precrack broke through to the next rivet.
3. At 3,551 cycles the right side (precrack side) broke through to the second rivet.
4. At 3,559 cycles the specimen failed. This is 2.5% of life.
5. Failure load - 75.4 KIPS.



FAILURE SURFACE

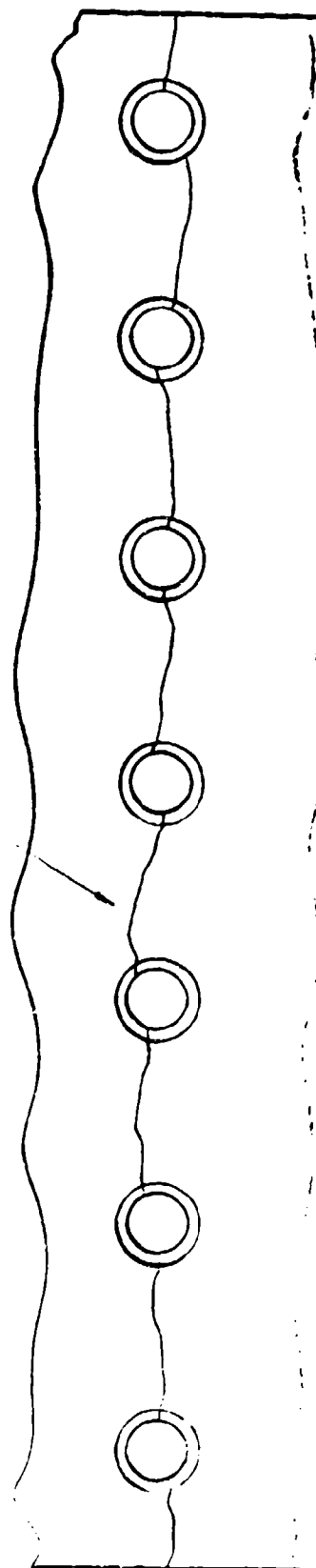


TABLE 6-16. CRACK MEASUREMENTS SPECIMEN LJ-26

SAMPLE NUMBER:	26	CYCLES TO FAILURE:	7,215
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	5.03
MAX LOAD (KIPS):	103.2	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMVS 1 Hz	HOLE DIAMETER:	0.312

1. At 5,608 cycles the precrack side of the flawed hole broke through to the next rivet.
2. At 7,215 cycles the specimen failed which was 5.03% of life.
3. Failure load - 80.0 KIPS.



FAILURE SURFACE

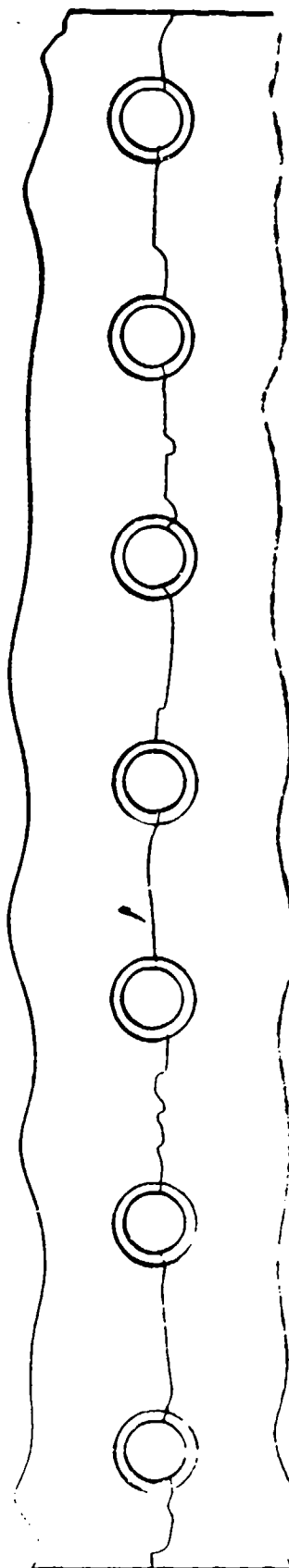


TABLE 6-17. CRACK MEASUREMENTS SPECIMEN LJ-27

SAMPLE NUMBER:	27	CYCLES TO FAILURE:	11,091
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	7.7
MAX LOAD (KIPS):	103.2	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMAVS 2 Hz	HOLE DIAMETER:	0.312

1. No crack growth data.
2. Failure at 11,091 cycles = 7.7% of life.
3. Failure Load - 92.3 KIPS.
4. Failed in main plate not cover plate. Rivet heads pulled through cover plate.



FAILURE SURFACE

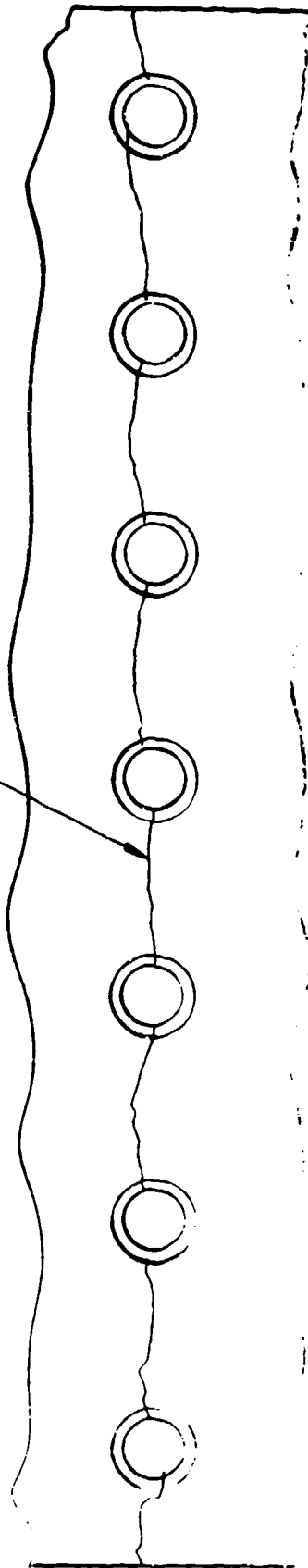


TABLE 6-18. CRACK MEASUREMENTS SPECIMEN LJ-28

SAMPLE NUMBER:	28	CYCLES TO FAILURE:	11,119
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	7.7
MAX LOAD (KIPS):	103.2	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMAVS 2 Hz	HOLE DIAMETER:	0.311

1. No crack growth data.
2. Failure at 11,119 cycles = 7.7% of life.
3. Failure load - 93.6 KIPS.



FAILURE SURFACE

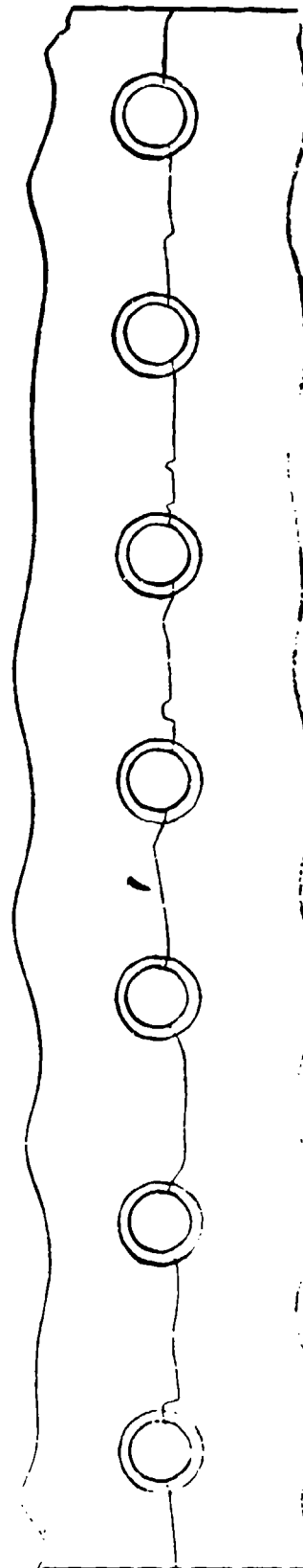


TABLE 6-19. CRACK MEASUREMENTS SPECIMEN LJ-29

SAMPLE NUMBER:	29	CYCLES TO FAILURE:	11,091
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	7.7
MAX LOAD (KIPS):	103.2	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMAVS 2 Hz	HOLE DIAMETER:	0.314

1. No crack growth data.
2. Failure at 11,091 cycles = 7.7% of life.
3. Failure load - 99.3 KIPS.

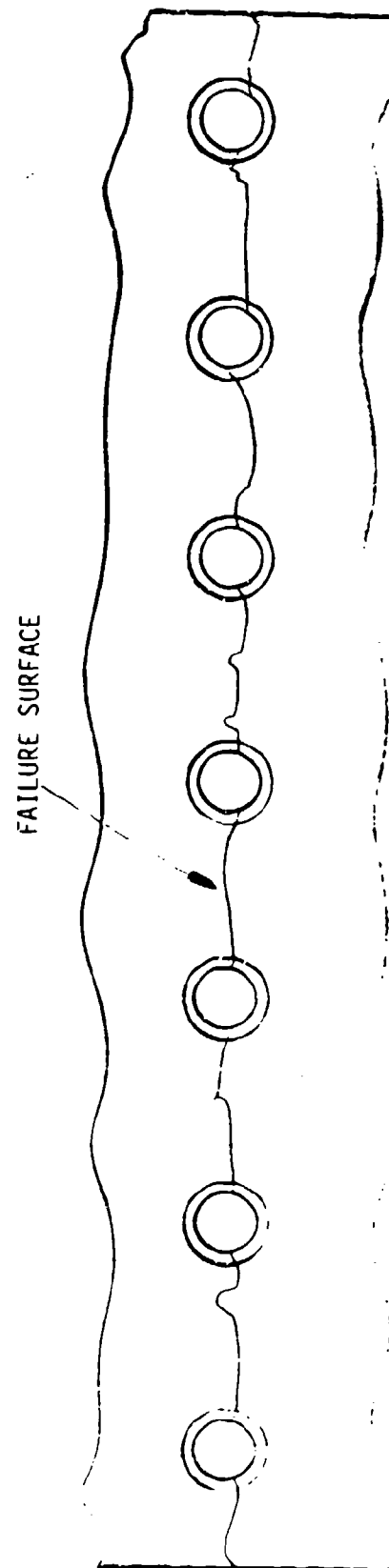
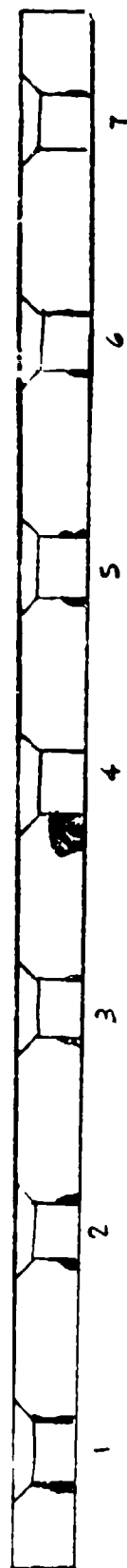
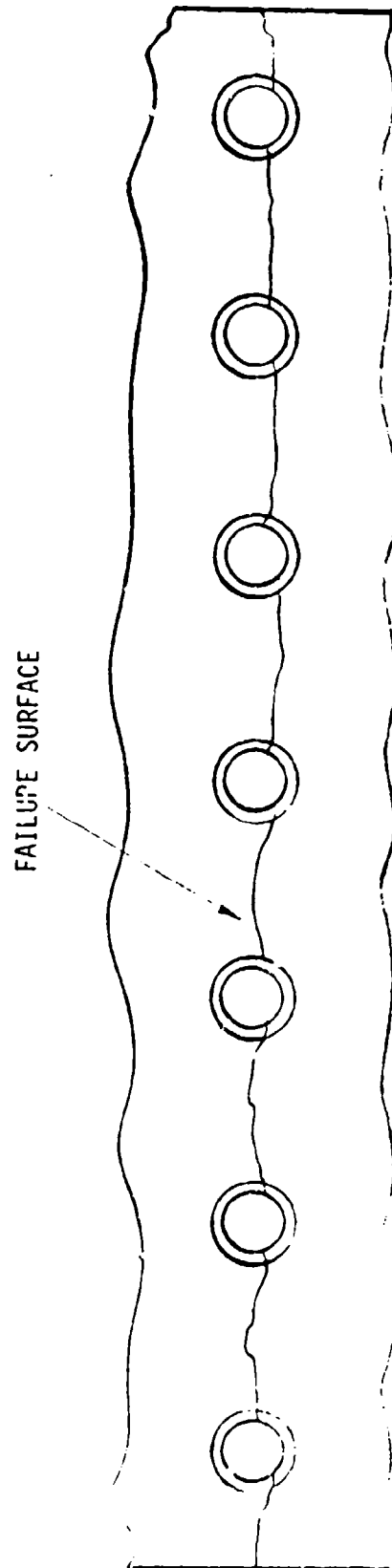


TABLE 6-20. CRACK MEASUREMENTS SPECIMEN LJ-30

SAMPLE NUMBER:	30	CYCLES TO FAILURE:	8,870
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	6.16
MAX LOAD (KIPS):	103.2	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMAVS 2 Hz	HOLE DIAMETER:	0.313

1. No crack growth data.
2. Failure at 8,870 cycles = 6.16% of life.
3. Failure Load - 91.5 KIPS.



7.0 DOUBLE-SHEAR LAP-JOINT TEST PROGRAM

The purpose of the double-shear lap-joint test program is similar to that of the single-shear lap-joint program, namely to assess the analytical methods in predicting crack growth of structural configuration often found in aircraft construction. The double-shear lap-joint provides redundancy in load path and eliminates some of the secondary effect due to changes in load path.

7.1 TEST SPECIMENS

A total of eighteen (18) double-shear lap-joint specimens were tested of 2024-T3 and 7075-T6 split skin spliced plates. The specimens configuration is shown in Figures 7-1 and 7-2. All specimens contained initial corner flaw of 0.050 inch located at the center fastener hole in the first row of fasteners through the skin making the splice plates more critical than the skin. The specimens were precracked prior to assembly. The initial flaw was introduced by means of saw-cut followed by constant amplitude fatigue loading not exceeding 40% of the yield stress. The loading was applied until a flaw of 0.050 in. was achieved.

The testing included three configurations;

- a. The base line was no interference fit fasteners, clamp-up or sealant at the faying surface.
- b. Specimens with clamp-up and interference fit hardware.
- c. Specimens with clamp-up, interference fit and sealant.

7.2 TEST DESCRIPTION

The double-shear lap-joint specimens were tested using a hydraulic, computer controlled MTS machine. Antibuckling plates were installed at both sides of the specimens to prevent lateral instability during compressive loading. The testing was performed in a Lab-Air environment at a frequency of 3 Hz. Figure 7-3 shows a specimen installed in the MTS machine. The precracking as well as the testing was performed at the University of Dayton Research Lab located in Dayton Ohio.

During the testing, measurements of crack growth were made using an optical method. A record of crack growth vs. number of cycles was recorded for each specimen, as well as the critical crack length measured at the fracture surface (Figures 7-15 through 7-33).

7.3 LOADING SPECTRA

The double-shear lap-joint specimens were subjected to three loading spectra;

- a. Constant amplitude loading spectrum,
- b. A-10A flight-by-flight loading spectrum,
- c. 'AMAVS' flight-by-flight loading spectrum.

The A-10A and the AMAVS loading spectra contained marker band cycles (Ref. Appendix A). Table 7-1 provides a description of the various specimens and loading configurations.

7.4 TEST RESULTS

The test results of eighteen (18) double-shear lap-joint specimens are summarized in Table 7-1, and shown for individual specimens in Figures 7-15 through 7-33. The scatter in the test data was within 30% except for specimen LJ-23, (interference fit, clamp-up and sealant) which had a scatter factor of 2.0. Specimens LJ-13 and LJ-14 (clearance fit, no clamp-up or sealant) and specimens LJ-17 and LJ-18 (interference fit, clamp-up and no sealant) were tested under constant amplitude loading at a maximum stress level of 13.1 Ksi and a minimum stress of 4.7 Ksi. Specimens LJ-13 and LJ-14 failed at 210,300 cycles and 217,800 cycles, respectively. However, specimens LJ-17 and LJ-18 did not fail at 2×10^6 cycles. Subsequently, a decision was made to increase the stress level of specimen LJ-21 (interference fit, clamp-up and sealant).

For specimens which were tested under randomized spectrum, the best results were obtained from those specimens with interference fit and clamp-up. The lives of those specimens were much higher (factor of 3-4) than the specimen without interference fit or clamp-up, and somehow higher than specimens containing sealant (\sim 30% - 40%). It is concluded that the presence of sealant at the faying surface tends to reduce the fatigue life and is mainly due to

the additional stress concentration at the faying surface. It must be mentioned that the test gross stress level of 37.75 Ksi is much higher than the acceptable maximum spectrum loading for aluminum alloys. A more realistic stress level is on the order of 30.0 Ksi to 32.0 Ksi.

The majority of the specimens exhibited cracking at both splice plates. Although, the critical crack size was not the same, it was on the same order of magnitude.

In contrast to the single-shear lap-joint specimens, relatively few cracks were initiated at holes adjacent to the initial crack section. A strain survey was performed on specimens LJ-13 and LJ-31 (Figure 7-4 and Tables 7-2 and 7-3). As expected, the survey shows a decrease in load adjacent to the cracked section (Figure 7-5).

7.5 FRACTOGRAPHIC ANALYSIS

Three (3) specimens were selected for Fractographic Examination. They included specimen LJ-19 which was subjected to A-10A loading spectrum, LJ-21 subjected to constant amplitude spectrum and specimen LJ-33 subjected to AMAVS loading spectrum. Specimens LJ-10 and LJ-21 were examined under a low power microscope, while specimen LJ-33 was examined under a Scanning Electron Microscope (SEM).

Crack starter flaws can be seen in most fracture faces in the center hole except where compressive loads have caused local damage. In most of the specimens, additional independent cracks had initiated in other holes. The presence of multiple holes with multiple cracks makes uncertain the determination of a clearly defined $\bar{\sigma}_{cr}$ since the segments of the cross section will tend to fail independently and sometimes sequentially.

The results of the examinations are presented as diagrams of the physical cross section showing origin directions and the extent of crack growth. Selected comments are appended appropriate to each specimen and appropriate photos are also appended. Crack lengths as well as the beginnings of fast fracture, can be directly derived from the diagrams and photos of marker bands.

All diagrams are viewed with the joint nuts on the upper side. Growth in the plane strain (flat) mode, plane stress (slant) mode and rapid fracture are separated on the diagrams.

Specimen LJ-19 (interference fit and hardware clamp-up) failed at 171,714 cycles of spectrum loading, or approximately 21 passes. One visible marker band appeared on the bottom and top plates (nut is in the top). The critical crack length of the top plate was approximately 2.5 in., while the lower plate was 1.5 in. The same proportionality appeared in the marker band distance from the hole (Figure 7-6). Also, the top plate appears to have more crack initiation sites than the bottom one. This may be attributed to higher stress level on the top plate or early crack initiation and subsequent growth.

Specimen LJ-21 exhibited similar behavior to LJ-19. The critical crack on the top plate (nut side of hardware) was approximately 4.0 in. long, while the bottom plate was approximately 3.0 in. long (Figure 7-7).

Fractographic examination of specimen LJ-33 revealed clear marking of the marker band cycles as indicated in Figures 7-8 through 7-10. The marking may be used to construct a revised crack growth diagram which shows the rates of growth at each interval of the testing. Additional fractographic examination was performed at hole No. 4 (initial flaw site) using the Scanning Electron Microscope (SEM). Polaroid photos of magnifications 10x, 50x, 300x, and 1000x were taken (Figures 7-11 through 7-14). The 10x photo shows the shape of the crack at various stages of its growth and its associated marker band (Figure 7-10). A single pronounced overload cycle may be seen periodically. Since the specimen failed at 92.45% of expected life, the number of overload cycles applied will be $92.45/7.8 = 12$, which is the number of 'crack jumps' counted on the fracture surface (Figure 7-10). The 50x polaroid shows intermediate marking corresponding to marker band sequencing as well as periodic jump in crack length due to overload cycles (Figure 7-12). Further magnification of the cracking surface, 300x and 1000x (Figures 7-13 and 7-14), revealed additional information as to the mode of crack extension adjacent to the initial flaw location.

TABLE 7-1. DOUBLE-SHEAR LAP-JOINT SPECIMENS SUMMARY TABLE

MATERIAL	SPECIMEN ID	TEST CONDITION	TYPE OF LOADING	STRESS (Ksi)	(1)CYCLES TO FAILURE
2024-T3	LJ 13 LJ 14	Clearance fit, no clamp-up, no sealant	Constant amplitude	13.1 max. 4.7 min.	210,300 217,800
	LJ 17 LJ 18	Interference fit, clamp-up, no sealant	Constant amplitude	13.1 max. 4.7 min.	2.35x10 ⁶ (*)(+) 2.08x10 ⁶ (*)
	LJ 21	Interference fit, clamp-up sealant	Constant amplitude	17.0 max. 1.7 min.	129,300
	LJ 15 LJ 16	Clearance fit, no clamp-up, no sealant	A-10 spectrum	37.75 max.	42,008 36,362
	LJ 19 LJ 20	Interference fit, clamp-up no sealant	A-10 spectrum	37.75 max.	171,714 179,255
	LJ 22 LJ 23 LJ 24	Interference fit, clamp-up, sealant	A-10 spectrum	37.75 max.	62,240 172,005 86,871
	LJ 31 LJ 32	Clearance fit, no clamp-up, no sealant	AMAVS spectrum	37.75 max.	47,637 45,860
	LJ 33 LJ 34	Interference fit, clamp-up, no sealant	AMAVS spectrum	37.75 max.	135,597 162,237
7075-T6	LJ 35 LJ 36	Interference fit, clamp-up, sealant	AMAVS spectrum	37.75 max.	103,461 137,937

(*) Did not fail

(+) Specimen LJ-17 was retested at $\sigma_{\max} = 17.0$ Ksi,
 $\sigma_{\min} = 1.7$ Ksi, the test life is 349,500 cycles.

(1) life time of A-10 Spectrum = 185,400 cycles

(1) life time of AMAVS Spectrum = 143,900 cycles

TABLE 7-2A. STRAIN SURVEY DATA OF SPECIMEN NO. LJ-13

Gage No. Cycles	1	2	3	4	5	6	7	8	Crack Length (inch)	
									Front	Rear
0.0	0.966	0.992	1.002	0.796	0.781	1.118	1.156	0.993	0.050	0.050
130,300	0.974	0.991	1.006	0.836	0.787	1.103	1.000	0.997	0.171	0.343
160,600	0.976	0.994	1.003	0.806	0.801	1.060	0.788	0.997	0.203	0.514
169,800	0.983	1.000	1.001	0.781	0.815	1.006	0.587	1.001	0.237	0.631
										(0.236)
173,000	0.988	1.007	0.997	0.767	0.826	0.977	0.322	1.006	0.250	0.750
										(0.344)
178,300	0.991	1.009	0.996	0.735	0.832	0.952	0.321	1.008	0.353	0.750
										(0.344)
183,600	0.996	1.013	0.995	0.698	0.838	0.923	0.330	1.011	-	0.750
										(0.462)
187,500	1.006	1.023	0.991	0.669	0.850	0.885	0.355	1.017	0.394	0.750
										(0.586)
189,900	1.027	1.042	0.980	0.641	0.857	0.837	0.388	1.029	0.750	0.750
										(0.750)
192,200	1.033	1.047	0.977	0.614	0.863	0.811	0.405	1.033	0.750	0.750
										(1.559)

- Note:
1. The specimen is 2024-T3 double-shear lap-joint specimen without interference, clamp-up, or sealant.
 2. Strain survey was performed at 12.6 ksi.
 3. The figures in the table are normalized with respect to remote strain
 4. The figures within the parentheses are the crack lengths at the opposite side of the precracked hole.

TABLE 7-2B. STRAIN SURVEY DATA OF SPECIMEN NO. LJ-31

Gage No. Life	1	2	3	4	5	6	7	8	9	10	Crack Length (inch)	
											Front	Rear
0 ⁽¹⁾	-0.015	-0.012	-0.051	-0.023	-0.006	-0.014	-0.007	-0.035	-0.051	0.001	NA	NA
0 ⁽²⁾	0.932	0.961	0.904	0.667	0.623	1.117	1.160	0.938	-0.013	0.115	NA	NA
2%	0.937	0.961	0.918	0.722	0.680	1.134	1.146	0.946	-0.046	0.115	NA	NA
2% ⁽³⁾	-0.042	-0.058	0.005	0.037	0.003	0.001	0.005	0.015	-0.984	-0.010	NA	NA
2% ⁽⁴⁾	0.925	0.907	0.923	0.720	0.670	1.128	1.145	0.928	-0.047	0.112	NA	NA
4%	0.911	0.927	0.923	0.779	0.712	1.444	1.163	0.920	-0.074	0.129	NA	NA
8%	0.897	0.948	0.908	0.783	0.741	1.130	1.153	0.905	-0.152	0.118	NA	NA
12%	0.884	0.965	0.899	0.799	0.765	1.085	1.117	0.890	-0.244	0.139	NA	NA
16%	0.885	0.991	0.952	0.027	1.425	0.463	1.007	0.871	-0.349	-0.019	0.165	0.138

- Note:
1. Strain readings were taken at zero load
 2. Strain readings were taken at 29.26 ksi unless otherwise noted.
 3. An error in test fixture was corrected; strain readings were taken at zero load.
 4. Strain readings were taken at 29.26 ksi after the error in test fixture was corrected.
 5. The specimen is 7075-T651 double-shear lap-joint specimen without interference, clamp-up, or sealant.
 6. The figures in the table are normalized with respect to remote stress.

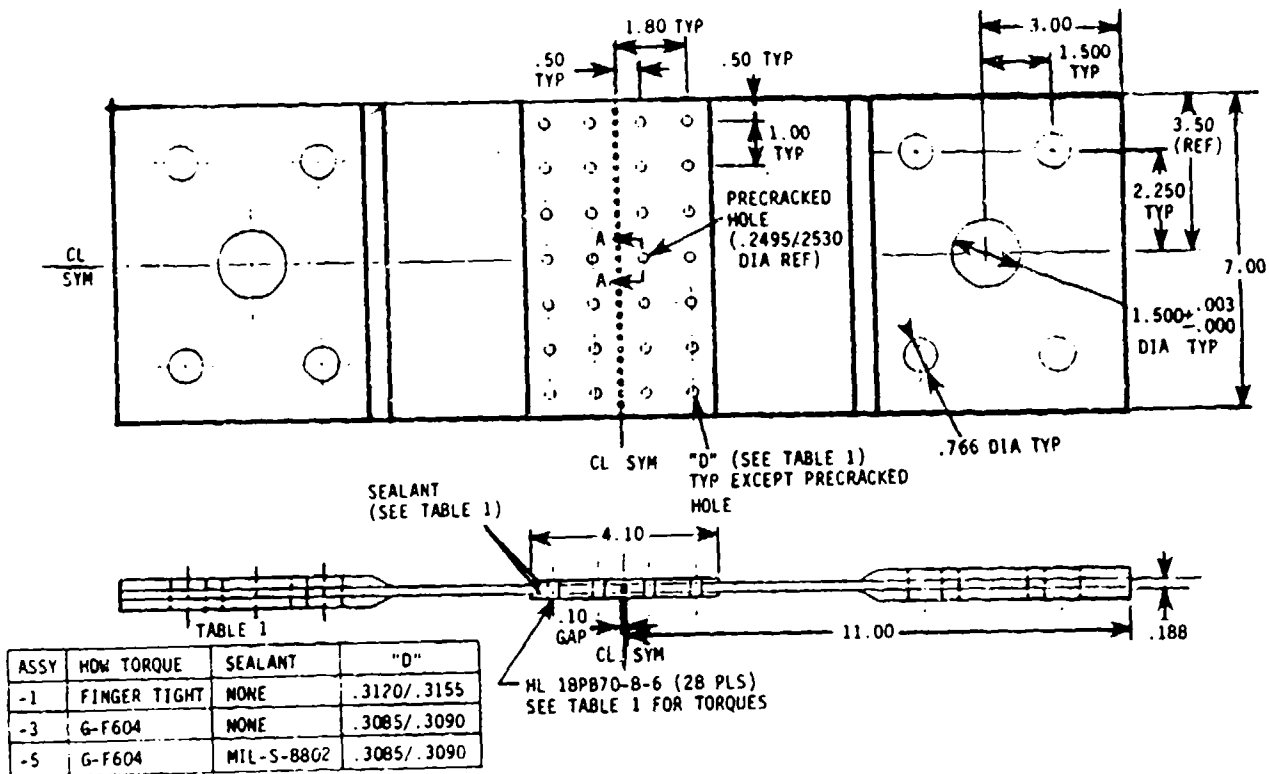


Figure 7-1. Double-Shear Lap-Joint Specimen Configuration (2024-T3XX)

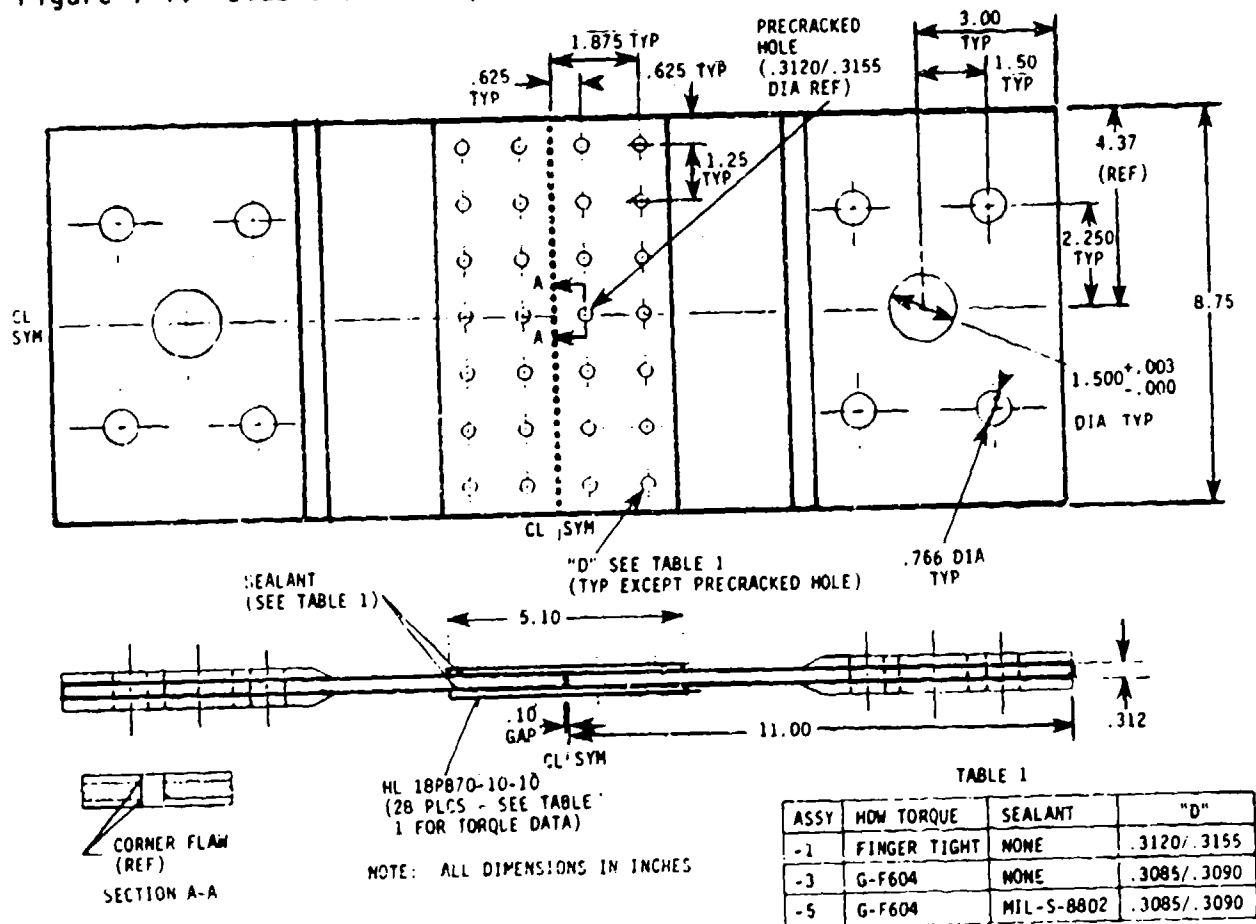


Figure 7-2. Double-Shear Lap-Joint Specimen Configuration (7075-T6XX)

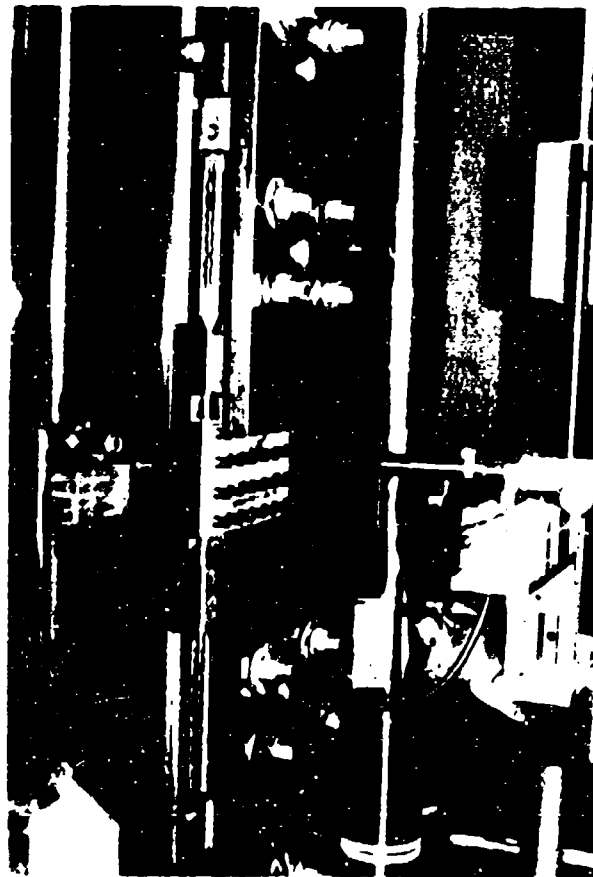


Figure 7-3. Test Set-Up, Typical Double-Shear Lap-Joint Specimen

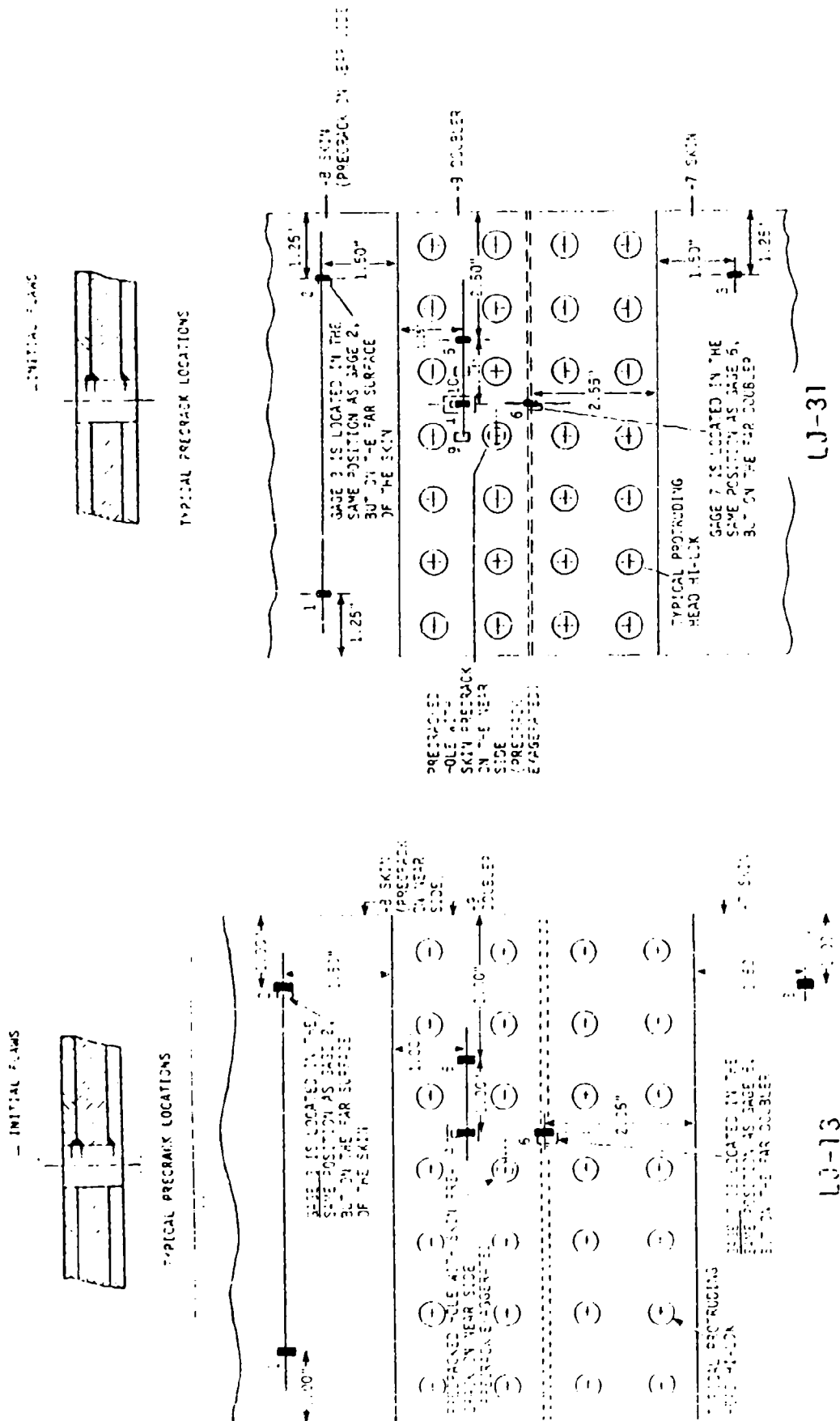


Figure 7-4. Strain Gage Locations Specimens LJ-13 and LJ-31

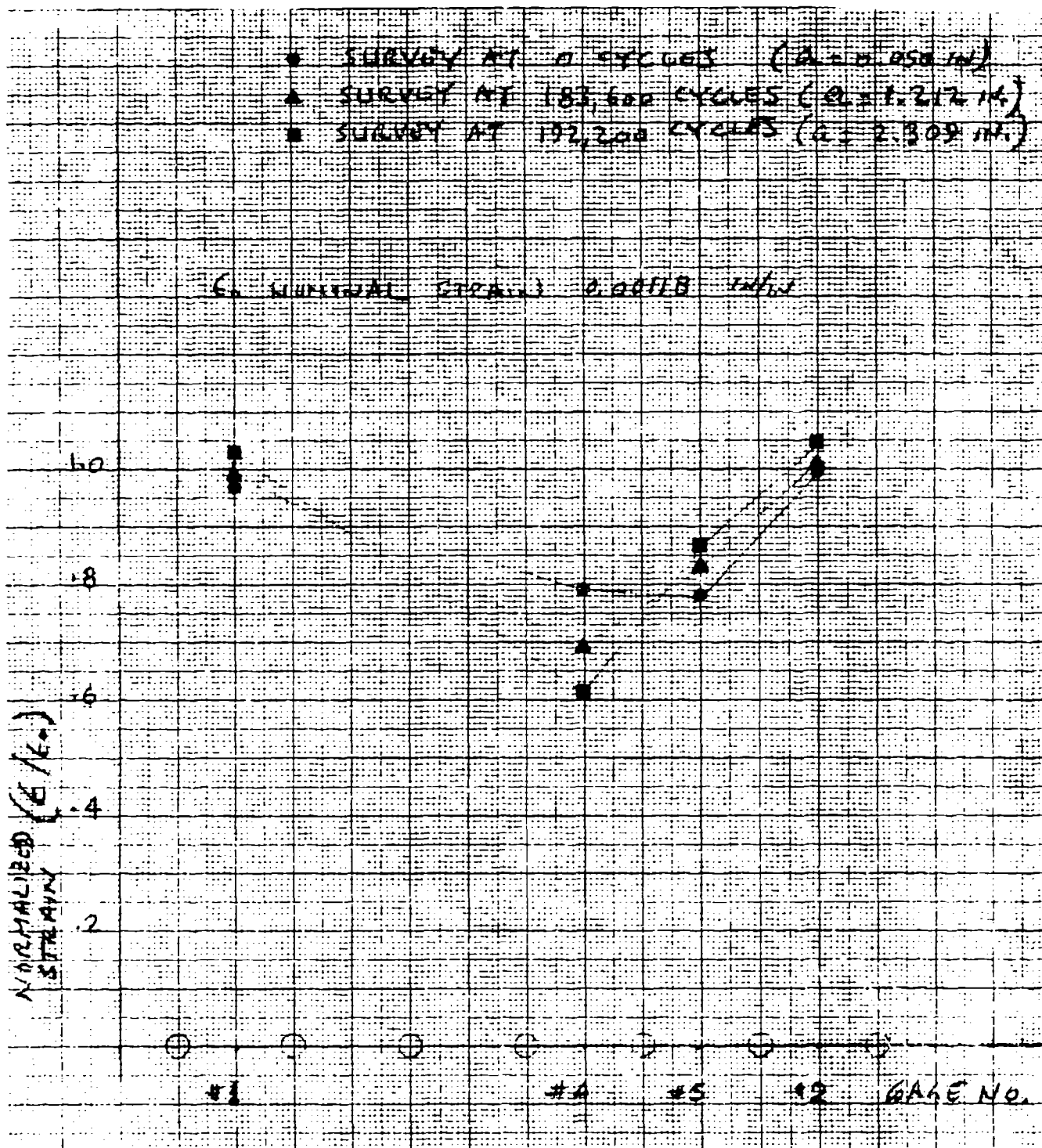
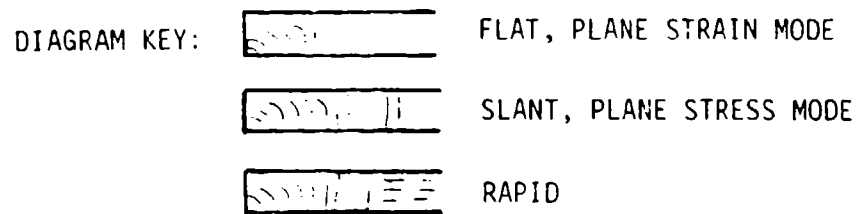


Figure 7-5. Strain Survey Double-Shear Lap-Joint Specimen LJ-13



NOTES: 1. 4 BAND-A-10 MARKERS SEEN AS INDICATED

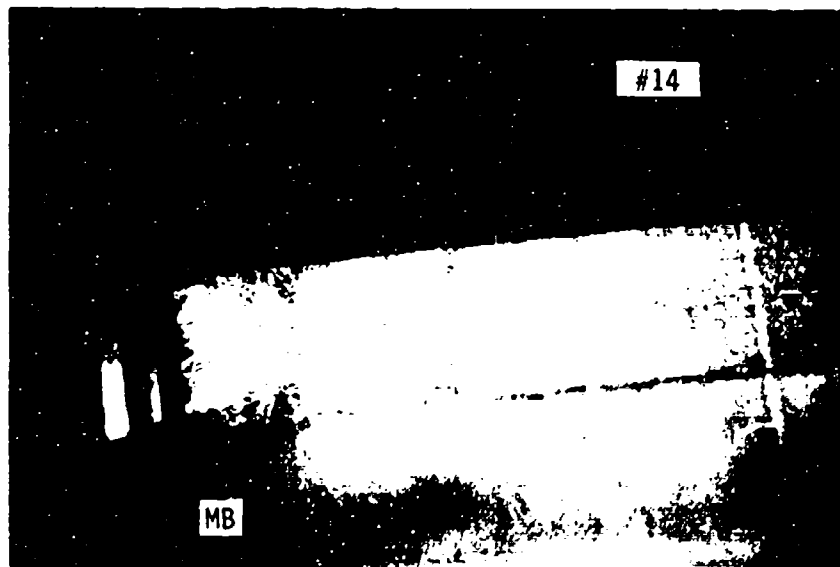
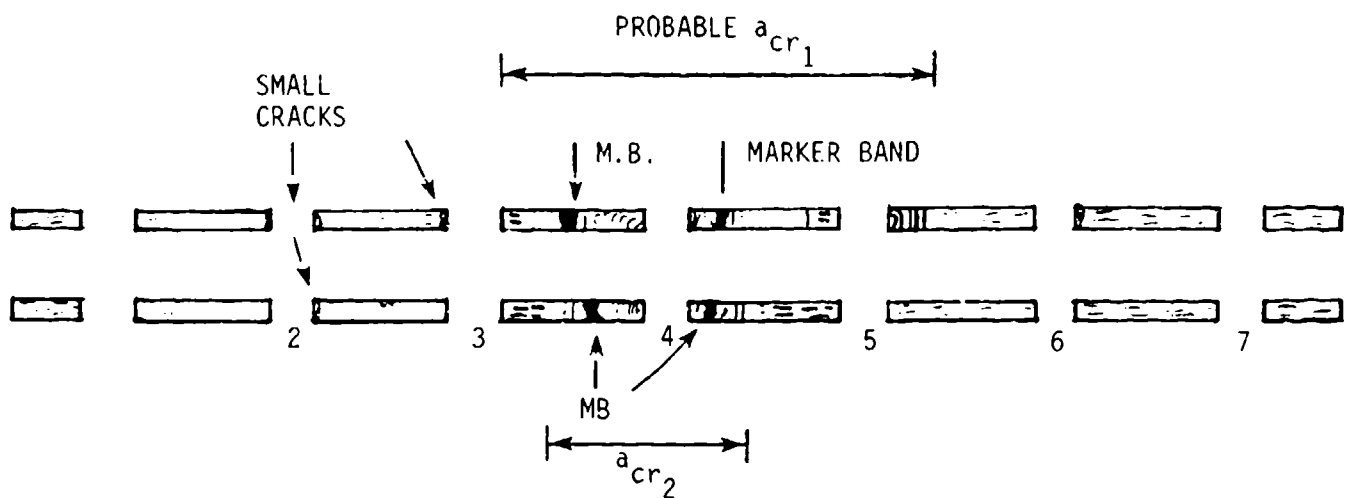
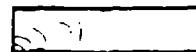


Figure 7-6. Fractographic Examination of Specimen LJ-19

DIAGRAM KEY:



FLAT, PLANE STRAIN MODE



SLANT, PLANE STRESS MODE



RAPID FRACTURE

NOTES: 1. NO UNUSUAL CONDITIONS

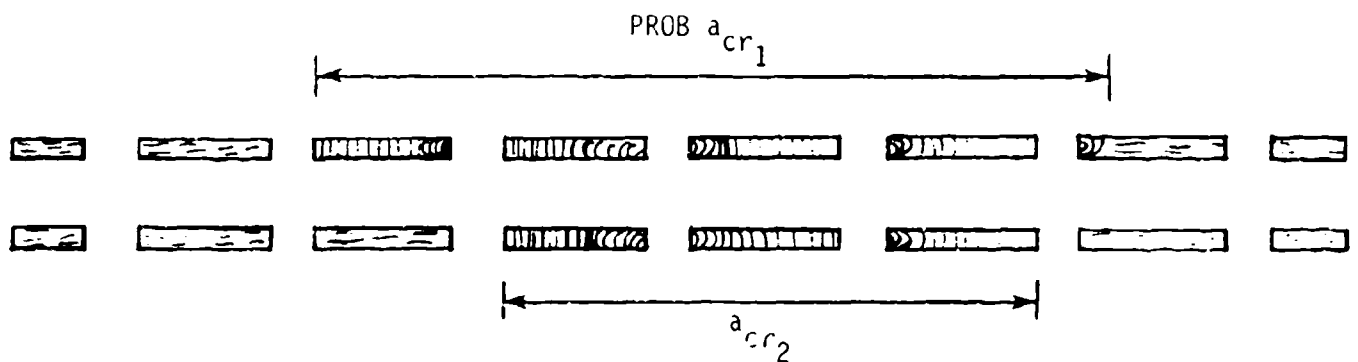


Figure 7-7. Fractographic Examination of Specimen LJ-21

NOTES: 7. REPEATED HIGH LOADS SAME AS MARKERS - SEE PHOTO

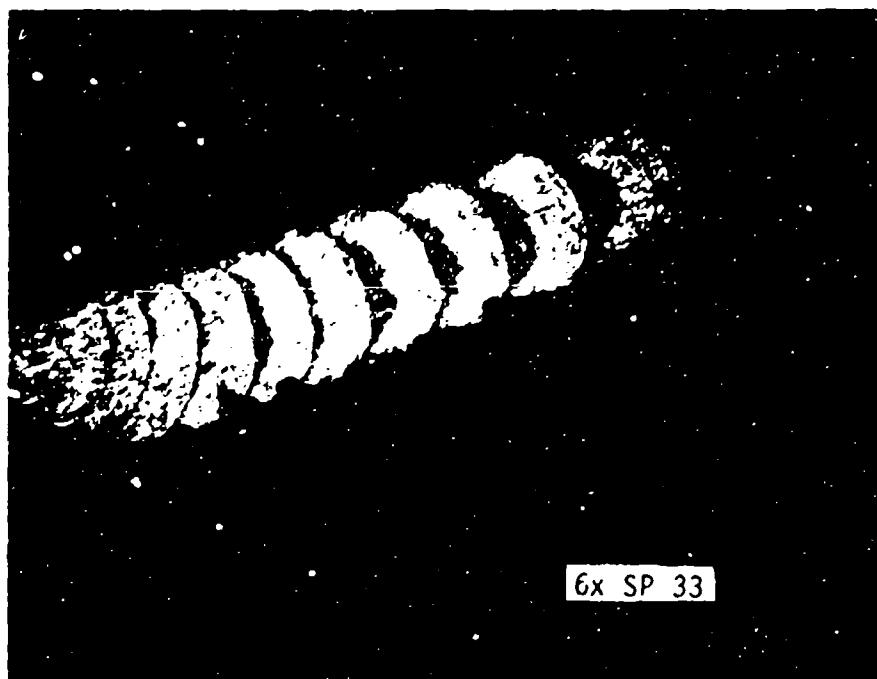
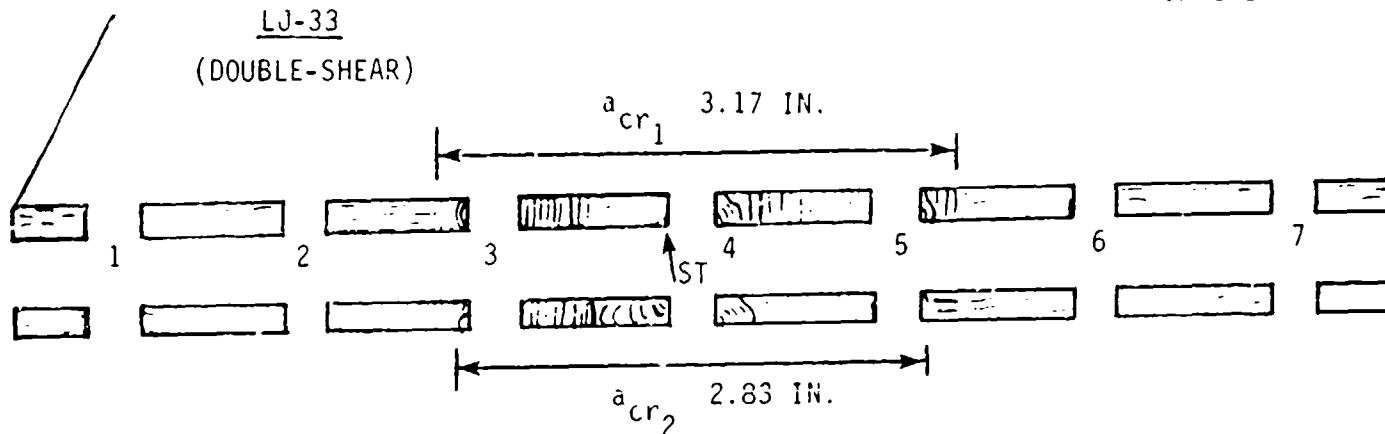
SPECIMEN

LJ-33

(DOUBLE-SHEAR)

REF. FIGURES

6-10 THROUGH 6-14



HOLE NO. 4

Figure 7-8. 6x Photo of Specimen LJ-33 Through Low-Power Microscope



Figure 7-9. 10x Photo of Specimen LJ-33 Through SEM

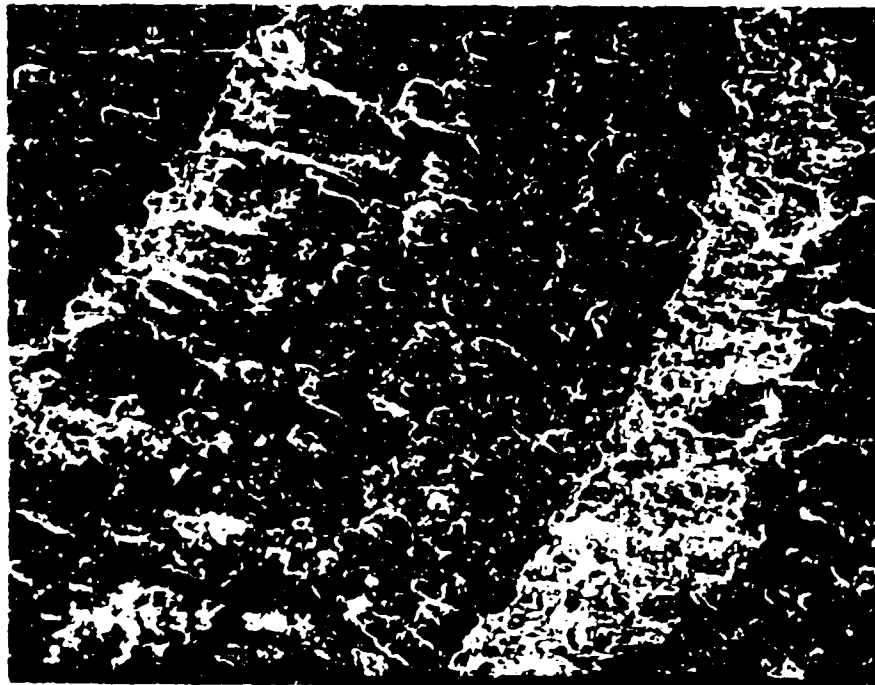


Figure 7-10. 50x Photo of Specimen LJ-33 Through SEM

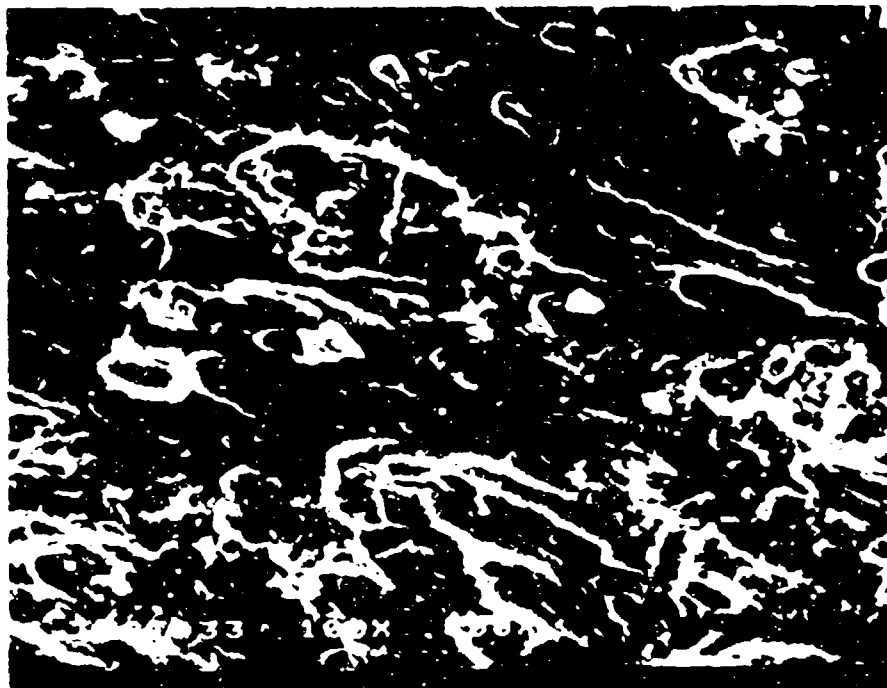


Figure 7-11. 300x Photo of Specimen LJ-33 Through SEM



Figure 7-12. 1000x Photo of Specimen LJ-33 Through SEM

TABLE 7-3. CRACK MEASUREMENT OF SPECIMEN LJ-13

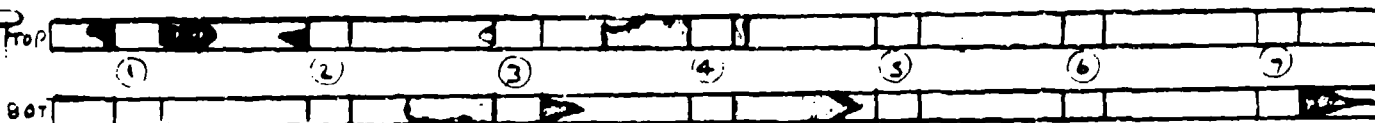
SAMPLE NUMBER:	13	CYCLES TO FAILURE:	210,300
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	NA
MAX LOAD (KIPS):	16.581/5.922	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	CA 7.5 Hz	HOLE DIAMETER:	0.250

CYCLES	DISTANCE FROM EDGE OF HOLE			
	FRONT		BACK	
	PRE-CRACK LEFT	HOLE RIGHT	PRE-CRACK LEFT	HOLE RIGHT
0	0.000	0.000	0.000	0.000
75500	0.000	0.000	0.125	0.000
98000	0.000	0.000	0.222	0.000
106300	0.000	0.075	0.250	0.000
111900	0.000	0.112	?	0.000
130400	0.000	0.171	0.343	0.000
146000	0.000	0.176	0.434	0.000
160600	0.000	0.203	0.514	0.000
169800	0.000	0.237	0.631	0.236
173000	0.000	0.250	TNR	0.246
178300	0.000	0.353	Same	0.344
183600	0.000	?	Same	0.462
187500	0.000	0.394	Same	0.586
189900	0.000	TNR	Same	TNR#1
192200	0.000	Same	Same	1.559
197200	0.000	Same	1.056	TNR#2
210300	Failure		Failure	

* New crack at next rivet left side
Distance from edge of second rivet

189900	0.173
197200	0.214

TNR = Through Next Rivet



Fracture Surface Examination Specimen LJ-13

TABLE 7-4. CRACK MEASUREMENT OF SPECIMEN LJ-14

SAMPLE NUMBER:	14	CYCLES TO FAILURE:	217,800
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	NA
MAX LOAD (KIPS):	16.581/5.922	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	CA 7.5 Hz	HOLE DIAMETER:	FRONT 0.250 BACK 0.252

CYCLES	DISTANCE FROM EDGE OF HOLE			
	FRONT		BACK	
	PRE-CRACK LEFT	HOLE RIGHT	PRE-CRACK LEFT	HOLE RIGHT
0	0.000	0.000	0.000	0.000
37200	0.000	0.000	0.097	0.000
39900	0.000	0.106	0.118	0.000
47900	0.000	0.135	0.137	0.000
58100	0.000	0.175	0.188	0.000
64400	0.000	0.187	0.211	0.000
84200	0.000	0.271	0.294	0.000
105700	0.000	0.367	0.405	0.000
120900	0.000	0.453	0.502	0.000
129100	0.000	0.515	0.580	0.000
133000	0.000	0.548	0.620	0.000
136300	0.000	0.574	0.658	0.000
138000	0.000	0.590	TNR	0.000
141600	0.000	0.630	Same	0.000
143800	0.000	0.674	Same	0.000
187000	0.000	TNR	Same	0.194
188200	0.000	Same	Same	0.227
189000	0.000	Same	1.141	0.242
190600	0.000	Same	1.181	0.275
192800	0.000	Same	1.218	0.318
194000	0.000	Same	1.256	0.347
195500	0.000	Same	1.297	0.384
196700	0.000	Same	1.322	0.416
198300	0.000	Same	1.364	0.467
199900	0.000	Same	1.428	0.523
201000	0.000	Same	1.471	0.575
202000	0.000	Same	1.497	0.680
202500	0.000	Same	1.592	TNR
203000	0.000	Same	TNR#2	Same
208300	0.000	Same	Same	1.178
208900	0.000	1.888	Same	1.243
209500	0.000	1.202	Same	1.298
210100	0.000	1.221	Same	1.351
210500	0.000	1.226	Same	1.404
211000	0.000	1.237	Same	1.472
211400	0.000	1.251	Same	1.551

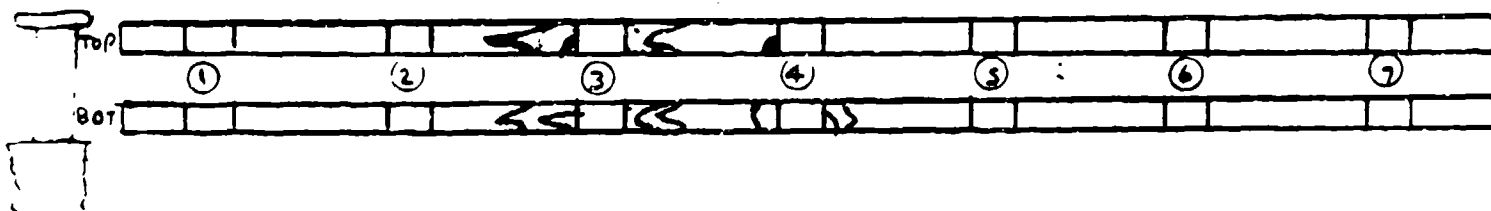
TNR - Through Next Rivet

TABLE 7-4. CRACK MEASUREMENT OF SPECIMEN LJ-14 (CONT.)

CYCLES	DISTANCE FROM EDGE OF HOLE			
	FRONT		BACK	
	PRE-CRACK LEFT	HOLE RIGHT	PRE-CRACK LEFT	HOLE RIGHT
211600	0.000	1.255	Same	1.637
212000	0.000	0.000	Same	TRN#2
212500	0.000	1.288	2.229	Same
212900	0.000	1.305	2.314	Same
213300	0.000	1.316	2.453	Same
213600	0.000	1.332	2.605	Same
213700	0.000	0.000	TNR#3	Same
215300	0.000	1.425	Same	Same
215600	No crack	1.504	TPE	Same
216000	No crack	1.632	TPE	Same
216900	0.320	TRN#2	TPE	Same
217200	0.448	Same	TPE	2.333
217400	0.566	Same	TPE	TNR#
217800	Failure	Failure	Failure	Failure

TNR = Through Next Rivet

TPE = To Panel Edge

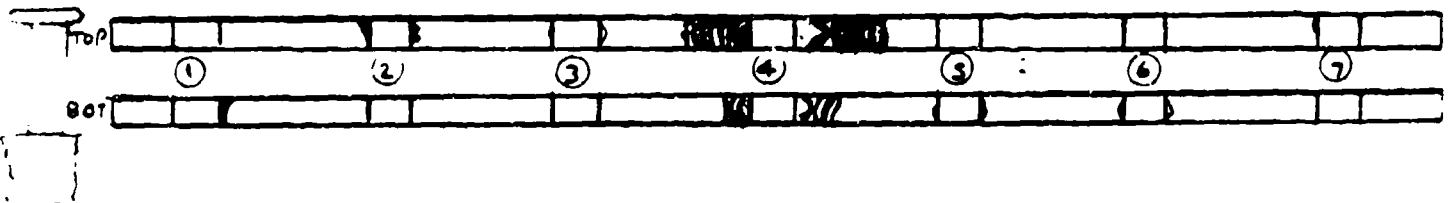


Fracture Surface Examination Specimen LJ-14

TABLE 7-5. CRACK MEASUREMENT OF SPECIMEN LJ-15

SAMPLE NUMBER:	15	CYCLES TO FAILURE:	42,008
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	21.35
MAX LOAD (KIPS):	49,700	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 3 Hz	HOLE DIAMETER: FRONT	0.254
		BACK	0.252

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE	
		FRONT PRE-CRACK HOLE <u>RIGHT</u>	BACK PRE-CRACK HOLE LEFT
0	0	0	0
1	4	0	0
2	8	.099	.002
3	12	.116	.125
4	16	.133	.159
5	20	.154	.235
	21.35	Failure	Failure



Fracture Surface Examination Specimen LJ-15

TABLE 7-6. CRACK MEASUREMENT OF SPECIMEN LJ-16

SAMPLE NUMBER:	16	CYCLES TO FAILURE:	36,362
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	18.0
MAX LOAD (KIPS):	49,700	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 3 Hz	HOLE DIAMETER:	0.254

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT	PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT
0	0	0.000	0.000	0.000	0.000
1	4	0.000	0.007	0.087	0.000
2	8	0.000	0.114	0.118	0.000
2.45	9.8	0.000	0.130	0.132	0.000
3	12	0.000	0.146	0.153	0.069
4	16	0.000	0.191	0.222	0.097
4.4	17.6	0.081	0.279	0.42	0.309
4.59	18.36	0.196	0.425	TNR	TNR
4.63	18.52	Failure	Failure	Failure	Failure

TNR = Through Next Rivet



Fracture Surface Examination Specimen LJ-16

TABLE 7-7. CRACK MEASUREMENT OF SPECIMEN LJ-17

SAMPLE NUMBER:	17	CYCLES TO FAILURE:	2.35 x 10 ⁶
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	
MAX LOAD (KIPS):	16.5/5.9	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	CA 7.5 Hz	HOLE DIAMETER: FRONT	0.251
		BACK	0.252

TNR = Through Next Rivet

CYCLES	DISTANCE FROM EDGE OF HOLE			
	FRONT		BACK	
	PRE-CRACK LEFT	HOLE RIGHT	PRE-CRACK LEFT	HOLE RIGHT
2024100	0.000	0.000	0.111	0.000
38700	0.000	0.000	0.210	0.000
48100	0.000	0.000	0.310	0.000
52700	0.000	0.095	0.363	0.000
60200	0.000	0.105	0.459	0.000
71700	0.000	0.231	0.668	0.000
2082800	0.000	0.341	TNR	0.000
2092400	0.000	0.459	Same	0.000
2100000	0.000	0.554	Same	0.000
2105600	0.000	0.653	Same	0.000
2121500	0.000	TNR	Same	0.000
2129900	0.000	Same	Same	0.260
133200	0.000	Same	Same	0.350
137500	0.000	Same	Same	0.490
139700	0.000	Same	Same	0.621
144300	0.133	Same	Same	TNR
2147500	0.216	Same	Same	Same
2151100	0.318	Same	Same	Same
2155400	0.438	Same	Same	Same
2158200	0.562	Same	Same	Same
2159900	TNR	Same	Same	Same
2314600	Same	1.173	Same	Same
2318300	Same	1.279	Same	Same
2322600	Same	1.373	Same	Same
2326400	Same	1.485	Same	Same
328800	Same	1.592	Same	Same
329700	Same	1.672	Same	Same
330200	Same	TNR#2	Same	Same
335000	Same	Same	Same	1.121
340800	Same	Same	Same	1.320
343400	Same	Same	Same	1.629
346100	Same	Same	Same	1.820
347700	Same	Same	Same	1.996
348600	Same	Same	Same	2.269
349000	Same	Same	Same	2.517
349400	Same	Same	Same	3.116
2351600	Failure		Failure	



Fracture Surface Examination Specimen LJ-17

TABLE 7-8. CRACK MEASUREMENT OF SPECIMEN LJ-18

SAMPLE NUMBER:	18	CYCLES TO FAILURE:	See Note 2
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE	NA
MAX LOAD (KIPS):	16.581/5.922	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	CA 7.5 Hz	HOLE DIAMETER:	FRONT 0.248 BACK 0.251

CYCLES	DISTANCE FROM EDGE OF HOLE			
	FRONT		BACK	
	PRE-CRACK LEFT	HOLE RIGHT	PRE-CRACK LEFT	HOLE RIGHT
145700	0.000	0.000	0.124	0.000
170800	0.000	0.000	0.174	0.000
208000	0.000	0.000	0.238	0.000
220400	0.000	0.000	0.274	0.000
241000	0.000	0.000	0.324	0.000
261900	0.000	0.000	0.382	0.000
277800	0.000	0.000	0.431	0.000
289800	0.000	0.000	0.481	0.000
334600	0.000	0.000	0.677	0.000

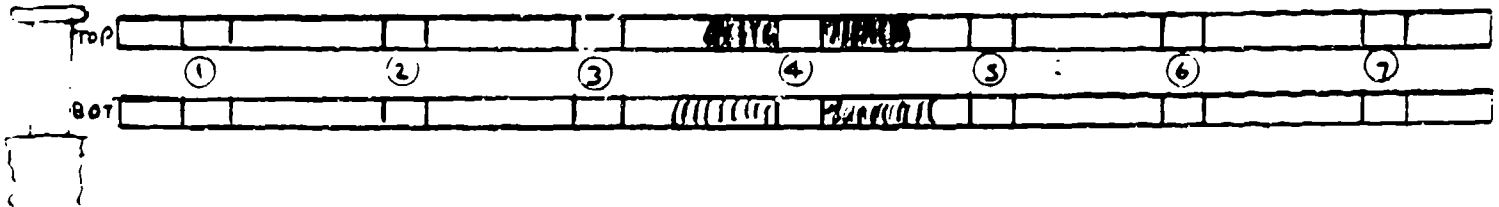
1. Crack broke to next rivet and arrested.
2. Test was terminated after 2.08×10^6 cycles.
3. Crack on front did not grow. Crack on back did not grow past the next rivet.

TABLE 7-9. CRACK MEASUREMENT OF SPECIMEN LJ-19

SAMPLE NUMBER:	19	CYCLES TO FAILURE:	171,714
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	84.0
MAX LOAD (KIPS):	49,700	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 3 Hz	HOLE DIAMETER: FRONT	0.252
		BACK	0.250

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK LEFT	HOLE RIGHT	PRE-CRACK LEFT	HOLE RIGHT
0	4	0.000	0.000	0.000	0.000
2	8	0.000	0.000	0.000	0.000
3	12	0.000	0.000	0.000	0.000
4	16	0.000	0.000	0.000	0.000
5	20	0.000	0.000	0.000	0.000
6	24	0.000	0.105	0.092	0.000
7	28	0.000	0.110	0.090	0.000
8	32	0.000	0.124	0.103	0.000
9	36	0.000	0.139	0.109	0.000
10	44	0.000	0.158	0.127	0.000
11	48	0.000	0.159	0.133	0.000
12	52	0.000	0.175	0.144	0.000
13	56	0.000	0.184	0.145	0.000
14	60	0.000	0.201	0.158	0.000
15	64	0.000	0.215	0.1711	0.000
16	68	0.000	0.236	0.182	0.000
17	72	0.000	0.270	0.192	0.000
17.40	73.6	0.000	0.289	0.207	0.000
18	76	0.130	0.313	0.218	0.000
19	80	0.169	0.354	0.239	0.000
20	84	0.242	0.432	0.274	0.102
21	88	TNR	TNR	0.435	0.270
21.02	88.08	Failure	Failure	Failure	Failure

TNR = Through Next Rivet



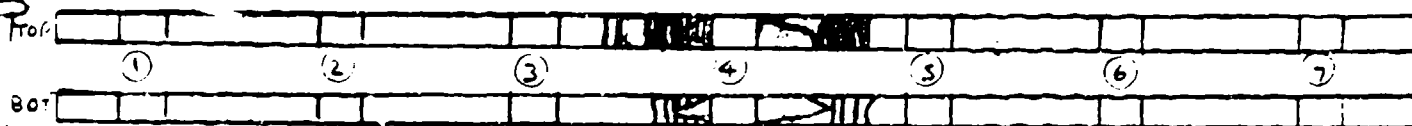
Fracture Surface Examination Specimen LJ-19

TABLE 7-10. CRACK MEASUREMENT OF SPECIMEN LJ-20

SAMPLE NUMBER:	20	CYCLES TO FAILURE:	179,255
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	95.6
MAX LOAD (KIPS):	49,700	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 3 Hz	HOLE DIAMETER: FRONT	0.252
		BACK	0.251

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT	PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT
0	0	0.000	0.000	0.000	0.000
1	4	0.000	0.000	0.000	0.000
3	8	0.000	0.000	0.000	0.000
4	12	0.000	0.000	0.000	0.000
5	20	0.000	0.092	0.080	0.000
6	24	0.000	0.101	0.086	0.000
7	28	0.000	0.109	0.100	0.000
8	32	0.000	0.119	0.105	0.000
9	36	0.000	0.131	0.128	0.000
10	40	0.000	0.151	0.141	0.000
11	44	0.000	0.158	0.152	0.000
12	48	0.000	0.165	0.159	0.000
13	52	0.000	0.174	0.160	0.000
14	56	0.000	0.180	0.176	0.000
15	60	0.000	0.189	0.192	0.000
16	64	0.000	0.200	0.204	0.000
17	68	0.000	0.215	0.222	0.000
18	72	0.000	0.228	0.232	0.000
18.87	75.48	0.000	0.241	0.262	0.092
20	80	0.000	0.251	0.292	0.122
21	84	0.085	0.287	0.327	0.152
22	88	0.146	0.326	0.385	0.206
23	92	0.231	0.436	0.530	0.347
23.21	92.84	Failure	Failure	Failure	Failure

TNR = Through Next Rivet

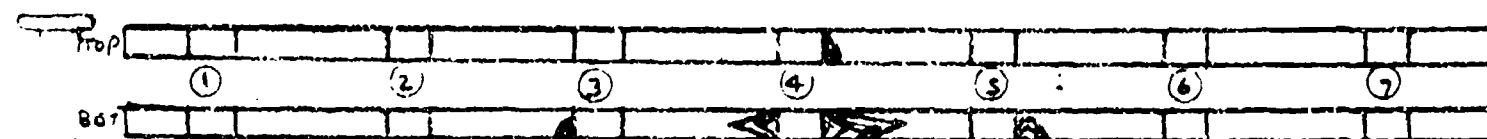


Fracture Surface Examination Specimen LJ-20

TABLE 7-11. CRACK MEASUREMENT OF SPECIMEN LJ-21

SAMPLE NUMBER:	21	CYCLES TO FAILURE:	129300
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	NA
MAX LOAD (KIPS):	22.4/2.2	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	CA 5 Hz	HOLE DIAMETER:	FRONT 0.251 BACK 0.251

CYCLES	DISTANCE FROM EDGE OF HOLE			
	FRONT		BACK	
	PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT	PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT
0	0.000	0.000	0.000	0.000
16400	0.000	0.102	0.000	0.000
20800	0.000	0.141	0.000	0.000
26500	0.000	0.197	0.000	0.000
31600	0.000	0.239	0.129	0.000
37700	0.000	0.317	0.166	0.000
45600	0.000	0.418	0.257	0.000
52500	0.094	0.534	0.332	0.000
57100	0.184	0.653	0.375	0.000
60900	0.309	TNR	0.445	0.000
64400	0.441	Same	0.499	0.000
67200	0.578	Same	0.562	0.000
69800	TNR	Same	0.677	0.000
74500	Same	Same	TNR	0.000
93900	Same	Same	Same	0.098
96000	Same	Same	Same	0.196
98200	Same	Same	Same	0.296
100100	Same	Same	Same	0.390
102500	Same	Same	Same	0.559
103200	Same	Same	Same	0.668
103500	Same	Same	Same	TNR
115300	Same	Same	Same	1.275
116600	Same	Same	Same	1.374
117600	Same	Same	Same	1.477
118300	Same	Same	Same	1.576
118600	Same	Same	Same	Same
119000	Same	Same	1.173	Same
120300	Same	Same	1.271	Same
121500	Same	Same	1.372	Same
122400	Same	Same	1.472	Same
123100	Same	Same	1.581	Same
123500	Same	Same	TNR#2	Same
125700	Same	1.181	Same	Same
126600	Same	1.310	Same	Same
127200	Same	1.410	Same	Same
127600	Same	1.508	Same	Same
127900	Same	1.622	Same	Same
128000	Same	TNR#2	Same	Same
128800	Same	Same	2.226	Same
129200	Same	Same	2.489	Same
129300	Failure		Failure	

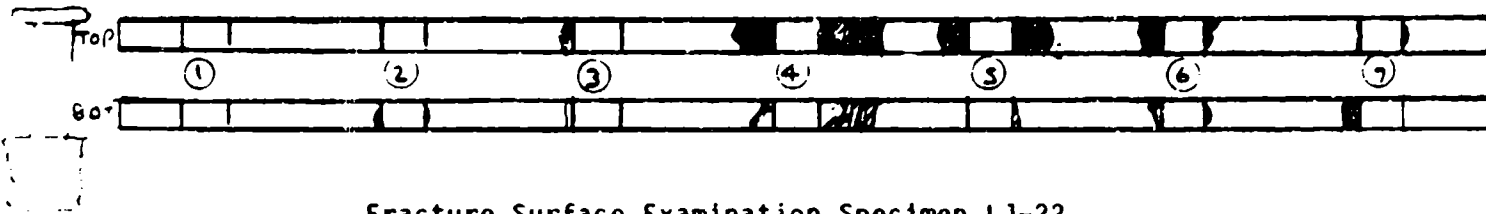


Fracture Surface Examination Specimen LJ-21

TABLE 7-12. CRACK MEASUREMENT OF SPECIMEN LJ-22

SAMPLE NUMBER:	22	CYCLES TO FAILURE:	62,240
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	31.92
MAX LOAD (KIPS):	49,700	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 3 Hz	HOLE DIAMETER:	FRONT 0.251 BACK 0.253

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT	PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT
0	0	0.000	0.000	0.000	0.000
1	4	0.000	0.000	0.000	0.000
2	8	0.000	0.000	0.000	0.000
3	12	0.000	0.000	0.073	0.000
4	16	0.000	0.102	0.114	0.000
5	20	0.000	0.106	0.130	0.000
6	24	0.000	0.133	0.152	0.000
7	28	0.000	0.152	0.190	0.000
7.98	31.92	Failure	Failure	Failure	Failure



Fracture Surface Examination Specimen LJ-22

TABLE 7-13. CRACK MEASUREMENT OF SPECIMEN LJ-23

SAMPLE NUMBER:	23	CYCLES TO FAILURE:	172,005
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	89.08
MAX LOAD (KIPS):	49,700	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 4 Hz	HOLE DIAMETER:	FRONT 0.251 BACK 0.252

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK LEFT	HOLE RIGHT	PRE-CRACK LEFT	HOLE RIGHT
0	0	0.000	0.000	0.000	0.000
1	4	0.000	0.000	0.000	0.000
2	8	0.000	0.000	0.000	0.000
3	12	0.000	0.000	0.000	0.000
4	16	0.000	0.000	0.000	0.000
5	20	0.000	0.096	0.000	0.000
6	24	0.000	0.110	0.000	0.000
7	28	0.000	0.111	0.000	0.000
8	32	0.000	0.122	0.000	0.000
9	36	0.000	0.134	0.000	0.000
10	40	0.000	0.143	0.000	0.000
11	44	0.000	0.149	0.081	0.000
12	48	0.000	0.161	0.094	0.000
13	52	0.000	0.168	0.108	0.000
14	56	0.000	0.177	0.116	0.000
15	60	0.000	0.189	0.136	0.000
16	64	0.000	0.200	0.149	0.000
17	68	0.000	0.205	0.169	0.090
18	72	0.000	0.222	0.190	0.120
19	76	0.000	0.237	0.209	0.134
20	80	0.000	0.262	0.244	0.163
21	84	0.103	0.301	0.296	0.215
22	88	0.202	0.380	0.417	0.347
22.29	89.16	Failure	Failure	Failure	Failure

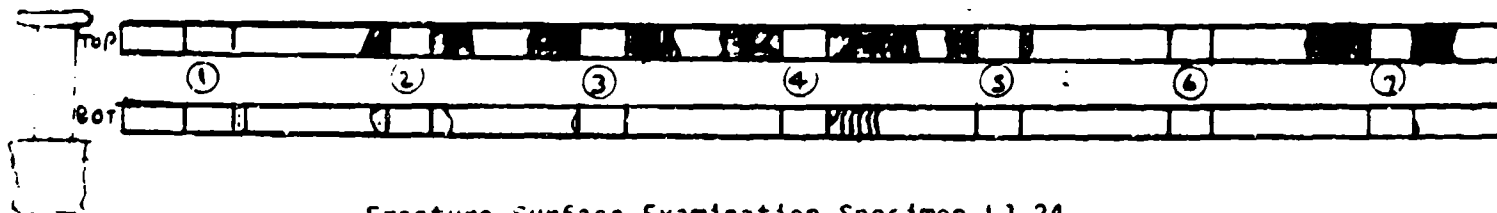


Fracture Surface Examination Specimen LJ-23

TABLE 7-14. CRACK MEASUREMENT OF SPECIMEN LJ-24

SAMPLE NUMBER:	24	CYCLES TO FAILURE:	86,871
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	44.72
MAX LOAD (KIPS):	49,700	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	A-10 4 Hz	HOLE DIAMETER:	FRONT 0.251 BACK 0.251

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK LEFT	HOLE RIGHT	PRE-CRACK LEFT	HOLE RIGHT
0	0	0.000	0.000	0.000	0.000
1	4	0.000	0.000	0.000	0.000
2	8	0.000	0.000	0.000	0.000
3	12	0.000	0.097	0.000	0.000
4	16	0.000	?	0.000	0.000
5	20	0.000	0.103	0.118	0.000
6	24	0.000	0.105	0.131	0.000
7	28	0.000	0.126	0.140	0.000
8	32	0.000	0.142	0.155	0.000
9	36	0.000	0.149	0.173	0.000
10	40	0.000	0.166	0.210	0.000
11	44	0.000	0.180	0.272	0.137
11.19	44.72	Failure	Failure	Failure	Failure



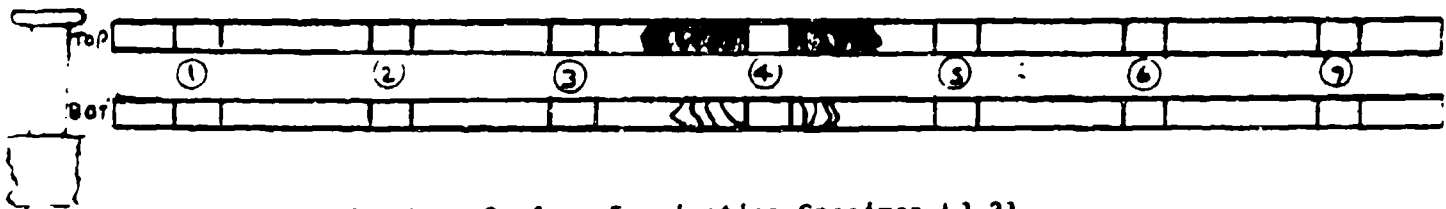
Fracture Surface Examination Specimen LJ-24

TABLE 7-15. CRACK MEASUREMENT OF SPECIMEN LJ-31

SAMPLE NUMBER:	31	CYCLES TO FAILURE:	47,637
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	32.47
MAX LOAD (KIPS):	103,200	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMAVS 3 Hz	HOLE DIAMETER:	FRONT 0.314 BACK 0.312

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT	PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT
0	0	0.000	0.000	0.000	0.000
1	7.84	0.000	0.000	0.000	0.000
2	15.68	0.165	0.000	0.000	0.138
3	23.52	0.298	0.000	0.000	0.226
4	31.37	TNR	TNR	0.113	0.348
4.14	32.47	Failure	Failure	Failure	Failure

TNR = Through Next Rivet

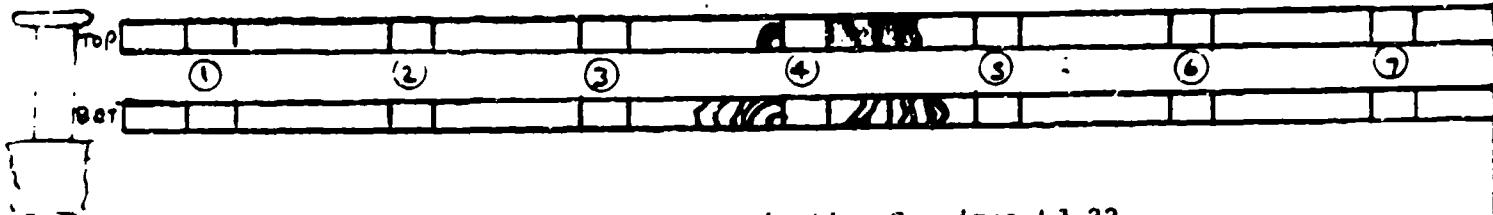


Fracture Surface Examination Specimen LJ-31

TABLE 7-16. CRACK MEASUREMENT OF SPECIMEN LJ-32

SAMPLE NUMBER:	32	CYCLES TO FAILURE:	45,860
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	31.25
MAX LOAD (KIPS):	103,200	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMAVS 4 Hz	HOLE DIAMETER:	FRONT 0.312 BACK 0.313

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK LEFT	HOLE RIGHT	PRE-CRACK LEFT	HOLE RIGHT
0	0	0.000	0.000	0.000	0.000
1	7.84	0.000	0.000	0.000	0.000
2	15.68	0.184	0.000	0.000	0.000
3	23.52	0.335	0.160	0.0000	0.000
3.986	31.25	Failure	Failure	Failure	Failure



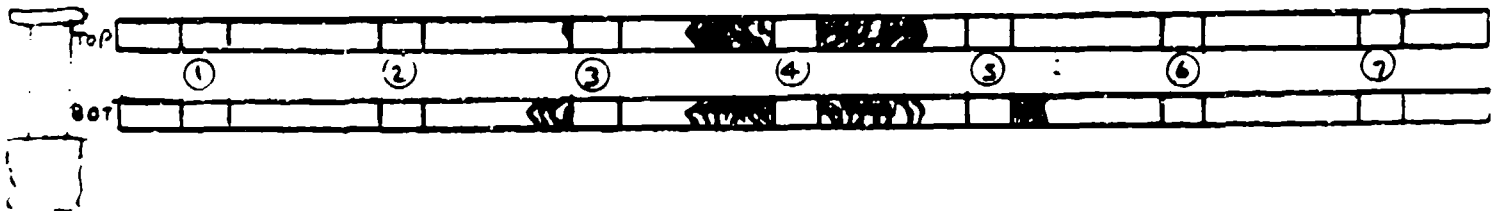
Fracture Surface Examination Specimen LJ-32

TABLE 7-17. CRACK MEASUREMENT OF SPECIMEN LJ-33

SAMPLE NUMBER:	33	CYCLES TO FAILURE:	135,597
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	92.45
MAX LOAD (KIPS):	103,200	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMAVS 4 Hz	HOLE DIAMETER: FRONT	0.311
		BACK	0.313

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK LEFT	HOLE RIGHT	PRE-CRACK LEFT	HOLE RIGHT
0	0	0.000	0.000	0.000	0.000
1	7.84	0.000	0.000	0.000	0.000
2	15.68	0.000	0.000	0.000	0.000
3	23.52	0.000	0.000	0.000	0.000
4	31.37	0.000	0.156	0.102	0.000
5	39.21	0.000	0.198	0.159	0.000
6	47.05	0.000	0.261	0.206	0.000
7	54.89	0.000	0.321	0.262	0.000
8	62.73	0.000	0.388	0.331	0.000
9	70.58	0.000	0.466	0.406	0.000
10	78.42	0.000	0.613	0.520	0.200
10.85	85.08	TNR	TNR	TNR	TNR
11	86.26	Same	Same	Same	Same
11.79	92.45	Failure	Failure	Failure	Failure

TNR = Through Next Rivet



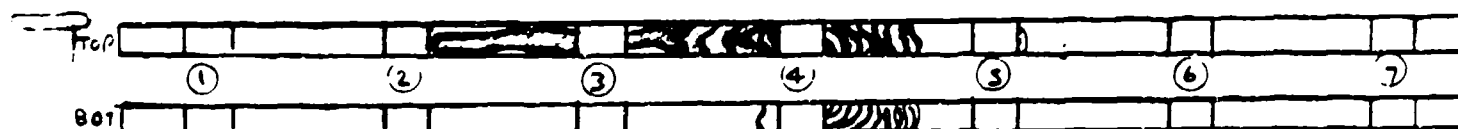
Fracture Surface Examination Specimen LJ-33

TABLE 7-18. CRACK MEASUREMENT OF SPECIMEN LJ-34

SAMPLE NUMBER:	34	CYCLES TO FAILURE:	162,237
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	110.49
MAX LOAD (KIPS):	103,200	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMAVS 7 Hz	HOLE DIAMETER:	FRONT 0.313 BACK 0.315

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT	PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT
0	0	0.000	0.000	0.000	0.000
1	7.84	0.000	0.000	0.000	0.000
2	15.68	0.000	0.000	0.000	0.000
3	23.52	0.000	0.000	0.000	0.000
4	31.37	0.000	0.000	0.156	0.000
5	39.21	0.000	0.0000	0.195	0.000
6	47.05	0.000	0.146	0.238	0.000
7	54.89	0.000	0.185	0.300	0.000
8	62.73	0.000	0.224	0.350	0.000
9	70.58	0.000	0.261	0.433	0.000
10	78.42	0.000	0.304	0.497	0.000
11	86.26	0.000	0.344	TNR	0.333
12	94.10	0.000	0.418	Same	TNR
13	101.94	0.000	0.512	Same	Same
14	109.79	TNR	TNR	TNR#2	Same
14.03	110.00	Same	Same	Same	TNR#2
14.09	110.49	Failure	Failure	Failure	Failure

TNR = Through Next Rivet



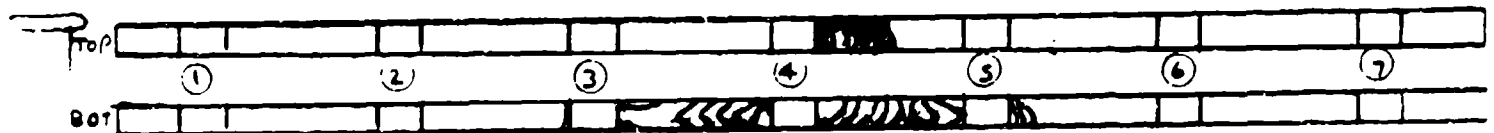
Fracture Surface Examination Specimen LJ-34

TABLE 7-19. CRACK MEASUREMENT OF SPECIMEN LJ-35

SAMPLE NUMBER:	35	CYCLES TO FAILURE:	103,461
SPECIMEN TYPE:	DOUBLE LAP JOINT	% OF LIFE AT FAILURE:	70.50
MAX LOAD (KIPS):	103,200	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMAVS 7 Hz	HOLE DIAMETER:	FRONT 0.313 BACK 0.315

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK LEFT	HOLE RIGHT	PRE-CRACK LEFT	HOLE RIGHT
0	0	0.000	0.000	0.000	0.000
1	7.84	0.000	0.000	0.000	0.000
2	15.68	0.000	0.000	0.000	0.000
3	23.52	0.000	0.000	0.000	0.000
4	31.37	0.143	0.000	0.000	0.207
5	39.21	0.191	0.000	0.000	0.281
6	47.05	0.238	0.000	0.000	0.374
7	54.89	0.286	0.000	0.000	0.508
8	62.74	0.364	0.000	TNR	TNR
8.99	70.50	Failure	Failure	Failure	Failure

TNR = Through Next Rivet



Fracture Surface Examination Specimen LJ-35

TABLE 7-20. CRACK MEASUREMENT OF SPECIMEN LJ-36

SAMPLE NUMBER:	36	CYCLES TO FAILURE:	137,937
SPECIMEN TYPE:	SINGLE LAP JOINT	% OF LIFE AT FAILURE:	94.02
MAX LOAD (KIPS):	103,200	FINAL CRACK LENGTH:	
SPECTRUM TYPE:	AMAVS 5 Hz	HOLE DIAMETER:	FRONT 0.314 BACK 0.311

PASS	% OF LIFE	DISTANCE FROM EDGE OF HOLE			
		FRONT		BACK	
		PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT	PRE-CRACK HOLE LEFT	PRE-CRACK HOLE RIGHT
0	0	0.000	0.000	0.000	0.000
1	7.84	0.000	0.000	0.000	0.000
2	15.68	0.000	0.000	0.000	0.000
3	23.52	0.108	0.000	0.000	0.000
4	31.37	0.163	0.000	0.000	0.127
5	39.21	0.221	0.000	0.000	0.185
6	47.05	0.267	0.000	0.000	0.216
7	54.89	0.332	0.000	0.000	0.273
8	62.73	0.406	0.000	0.000	0.348
9	70.58	0.542	0.000	0.000	0.433
10	78.42	TNR	0.000	0.000	0.590
11	86.26	Same	0.230	0.088	TNR
11.99	94.02	Failure	Failure	Failure	Failure

TNR = Through Next Rivet



Fracture Surface Examination Specimen LJ-36

8.0 STRINGER REINFORCED SPECIMENS TEST PROGRAM

The purpose of the stringer reinforced test program was to access the state-of-the-art analytical capabilities in predicting crack growth life of specimen configurations typical to that which exist in aircraft.

8.1 TEST SPECIMENS

A total of thirty-six (36) stringer-reinforced specimens were tested. The specimens were made of 2024-T3XX and 7075-T6XX aluminum alloy representative of materials used in the lower wing cover of fighter/trainer and bomber/cargo type aircrafts, respectively. Four (4) specimen configurations were tested, including (Ref. Table 8-1):

- a. Continuous skin, center 'TEE' stringer.
- b. Split skin, center 'TEE' stringer.
- c. Continuous skin, center 'L' stringer.
- d. Continuous skin, edge 'L' stringer.

A photo of specimens No. GT221K0011-7A and -5B are shown in Figure 8-1. Cross section illustration of each of the specimens is shown in Figure 8-2 through 8-7. All specimens contained an initial flaw ($a = 0.050$ in.) located at the edge of an attachment hole. The specimens were precracked prior to assembly. The initial flaw was introduced by means of a saw-cut, followed by the application of a constant amplitude load spectrum. The magnitude of the load did not exceed 40% of the yield stress of the material. The specimens were then assembled. The precracked holes had always clearance fit hardware with no clamp-up. The adjacent holes had interference fit hardware and the appropriate clamp-up.

8.2 TEST DESCRIPTION

The stringer reinforced specimens were tested using a MTS, hydraulic computer controlled testing machine. Anti-buckling plates were installed on both sides of the specimens to prevent lateral instability during compressive loading. The testing was performed at the University of Dayton Research Center in a Lab-Air environment and a loading frequency of 3 Hz. Measurements of crack length vs. number of cycles were recorded. Using optical means (Table 8-3 through 8-44), a strain survey were taken before and during the tests (Ref. Tables 8-6, 8-17, 8-25, 8-31, 8-36 and 8-41).

8.3 LOADING SPECTRA

The stringer reinforced specimens were subjected to either a constant amplitude loading or a flight-by-flight loading. The flight-by-flight loading included the A-10A and the AMAVS randomized loading spectra. The maximum and the minimum stress levels are given in Table 8-2. Marker band cycles were included in the A-10A and the AMAVS loading spectra (Ref. Volume III).

8.4 TEST RESULTS

The test results obtained from thirty-six (36) stringer reinforced specimens are presented in Table 8-2. In general, the test results show wider scatter in number of cycles to failure than those obtained from the lap-joint specimens. This may be attributed to the geometrical complexity of the stringer-reinforced specimens. Table 8-2 contains critical crack length measurements taken during the test as well as the crack length measured after specimen failure. In some instances there is a wide variation between the two sets of measurements. The individual crack length data and strain survey of specimens No. 40, 50 and 56 are presented in Tables 8-3 through 8-44.

8.4.1 Test Results of Specimens Subjected to A-10A Loading Spectrum

The test results obtained from twelve (12) stringer-reinforced specimens subjected to an A-10A loading spectrum, indicate a substantially higher life for L-center stringer specimen than the T-center or the L-edge specimens. This may be attributed to the relative cross sectional area of the stringer section to the specimen section. The above ratio for the T-center and the L-edge specimens are approximately 20%, while the L-center is 10%. Therefore, the failure of the stringer in the case of the L-center contributed less in stress rise than the other two cases. The lowest life was obtained from the L-edge specimen. This may be attributed to the eccentricity of the load distribution that causes uneven load distribution along the specimen cross section. The scatter in the total life for the L-edge type specimen was the worst of the three. Specimen No. 55 failed at 100,823 cycles vs. 160,900 cycles for specimen 56. The reason of the relatively large deviation in crack growth life between specimen No. 55 and specimen No. 56 was attributed to unintentionally extra drilled 0.125 in. diameter hole located at the fracture surface (Figure 8-10). A clear marking of crack initiation may be seen at the drilled hole.

The critical crack length exhibited a similar trend. For the L-center specimens (average of 4 specimens) the critical crack length was 8.4 in., compared with 4.6 in. and 3.67 in. for the T-center and L-edge specimens, respectively.

A strain survey of specimens 40, 50 and 56, indicate fairly uniform stress distribution until stringer failure. The strain surveys are presented in Tables 8-6, 8-17 and 8-24, respectively.

8.4.2 Test Results of Specimens Subjected to AMAVS Loading Spectrum

The test results of the stringer reinforced specimens subjected to the AMAVS loading spectrum are presented in Table 8-2. Specimens No. 61 through 68 were loaded at a maximum stress level of 30.5 Ksi, while specimens No. 69 through 72 were loaded at a maximum stress of 21.5 Ksi. The largest scatter in life occurred in the T-center split skin specimens. Specimen No. 65 failed at 259,515 cycles, while specimen No. 66 failed at 101,023 cycles. Among the T-center specimens, the continuous skin specimens had higher life to failure. Although none of the split skin specimens showed any indication of crack initiation at the adjacent plate, their corresponding life was shorter. Also, the critical crack length for the split skin specimens was smaller than the continuous skin specimens. The average crack lengths to failure were 5.275 in., 3.275 in. and 4.975 in. for T-center continuous skin, T-center split skin and L-edge, respectively. The average fracture toughness of the specimen was approximately 100 Ksi in. A strain survey of specimens No. 62, 66 and 70 are shown in Tables 8-31, 8-36 and 8-41, respectively.

8.4.3 Test Results of Specimens Subjected to Constant Amplitude Loading Spectrum

The specimens which were subjected to a constant amplitude loading spectrum exhibited the best results with respect to scatter. Among similar specimens, the highest amount of scatter was observed for the TEE-center specimens. The failure occurred at 55,960 cycles and 74,330 cycles for specimens No. 41 and 42, respectively. The highest variation in the number of cycles to failure

was found in the L-edge specimens. The failure occurred at 67,136 cycles and 87,647 cycles for Type A and Type B respectively.

The highest average number of cycles to failure was obtained from the L-edge specimens. The failure occurred at 77,400 cycles vs. 74,500 and 65,450 cycles for L-center and TEE-center specimens respectively.

The critical crack length at failure was fairly uniform. The average crack length of twelve (12) specimens was 11.0 inches. The corresponding fracture toughness was $K_{IC} = 120 \text{ Ksi } \sqrt{\text{in.}}$.

8.5 FRACTOGRAPHIC ANALYSIS

Four (4) stringer reinforced specimens were selected for fractographic examination. The purpose of the examination was to determine the fracture surface characteristics for the initiation and growth of the cracks. The examinations were performed under a low-power microscope. The specimens examined included No.'s 57, 60, 63 and 67. Figures 8-9 through 8-16 show the fracture surfaces of some of the specimens subsequent to failure.

8.5.1 Specimen No. 57 Fractographic Analysis

Specimen No. 57 consisted of an edge-stringer reinforced skin. It was made of 2024-T3 sheet and 2024-T3511 extruded angles. The specimen was subjected to a constant amplitude load spectrum with a maximum stress level of 17.0 Ksi and stress ratio of $R = 0.10$. The specimen failed at 92,784 cycles.

The fractographic examination revealed slow crack growth at the extruded angle, with some initiation at the adjacent hole. The vertical member of the angle contained very little evidence of crack initiation. The stringer failed with relatively small cracks present, being on the order of 0.25 inch on each side of the hole. However, the skin contained much more crack growth, starting with plane strain growth and followed by plane stress up to final failure. The critical crack length at failure was determined to be $a_{cr} = 11.75$ inches. The initial flaw was visible at the hole close to the stringer's up-standing leg. The fracture toughness was determined to be in the order of $100\text{--}120 \text{ ksi } \sqrt{\text{in.}}$. Figures 8-11A and 8-11B show the fracture surfaces subsequent to failure.

8.5.2 Specimen No. 60 Fractographic Analysis

Specimen No. 60 consisted of an edge-stringer reinforced skin. It was made of 2024-T3 sheet reinforced by two edge members made of 2024-T3511 extruded angle. The specimen was subjected to the A-10A loading spectrum and contained marker band cycles. The maximum and minimum stress levels were 37.5 Ksi and -8.34 Ksi, respectively. The specimen failed at 130,030 cycles (≈ 17 passes). The fractographic analysis did not reveal any significant amount of crack initiation at the adjacent hole. The total length of the stringer crack was on the order of 1.4 inches, while the skin contained 3.0 inches of stable cracking. Clear marker band serrations were visible at the skin and stringer fracture surface. As expected, the crack growth rate in the stringer flange slowed substantially upon approaching the upstanding leg, while growth in the skin accelerated. Figures 8-12A and 8-12B show the fracture surface subsequent to failure.

8.5.3 Specimen No. 63 Fractographic Analysis

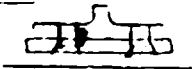
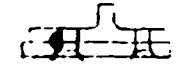
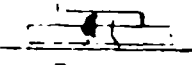
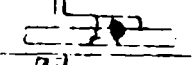
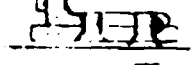

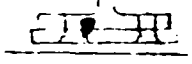
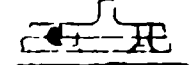
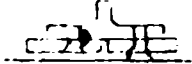
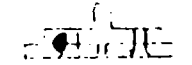
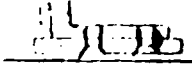
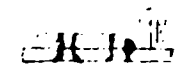
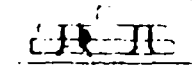
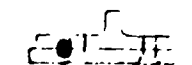

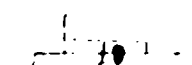
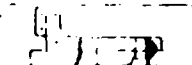
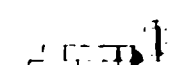
Specimen No. 63 consisted of tee-stringer reinforced continuous skin. The specimen was made of 7075-T6 sheet attached to 7075-T651 extruded angle. The specimen was subjected to the 'AMAVS' loading spectrum containing marker band cycles. The maximum and minimum stress levels were 30.5 Ksi and -6.64 Ksi, respectively. The specimen failed at 156,117 cycles (≈ 13 passes). The fractographic examination revealed clear markings corresponding to high load cycles. The crack growth rates slowed down substantially when the crack approached the upstanding leg of the stringer. The crack had plane strain characteristics up to a length of 0.9 inch in the stringer and 1.65 inches in the skin, subsequently, the mode of propagation changed to plane stress until final failure. The critical crack length in the stringer was 2.2 inches in the flange section and 0.60 inch in the upstanding leg section. The critical length in the skin was 4.60 inches. Contrary to expectation, there was no crack initiation at the adjacent hole. Figures 8-13A through 8-13C show the fracture surface subsequent to failure.

8.5.4 Specimen No. 67 Fractographic Analysis

Specimen No. 67 consisted of tee-stringer reinforced split skin. The specimen was made of 7075-T6 skin attached to 7075-T651 extruded angle. It was subjected to the 'AMAVS' load spectrum, including marker band cycles. The

maximum and minimum stress levels were 30.5 Ksi and -6.64 Ksi, respectively. The specimen failed at 152,511 cycles (\approx 13 passes). The fractographic examination revealed slow crack growth on one side of the specimen with very little initiation on the opposite side of the hole. The critical crack length was 0.50 inch and 2.3 inches in the stringer and skin, respectively. The adjacent skin did not contain any cracking, but failed statically. Figures 8-15 and 8-15B show the fracture surface subsequent to failure.

TABLE 8-1. STRINGER-REINFORCED SPECIMEN GEOMETRIES

SPECIMEN TYPE	FLAW CONFIGURATION	DASH NO. *	TEST ID	SKIN		STRINGER			GROSS AREA (IN ²)
				W (IN)	t (IN)	A (IN ²)	I _{xx4} (IN ⁴)	C.G. (IN)	
Center T-Stringer Continuous Skin		-1A	39,40	18.0	.188	0.899	.4161	.5813	4.283
		-1B	43,44						
Center L-Stringer Continuous		-3A	47,48	18.0	.188	.3383	.1365	.6227	3.722
		-3B	50,52						
Edge L-Stringer Continuous Skin		-5A	55,56	18.0	.188	1.382	1.2222	0.917	6.148
		-5B	59,60						
Center T-Stringer Continuous Skin		-7A	61,62	18.0	0.312	1.5966	0.9719	0.7125	7.212
		-7B	63,64						
Center T-Stringer Split Skin		-9A	65,66	18.0	0.312	1.5966	.9719	.7125	7.182
		-9B	67,68						
Edge L-Stringer Continuous Skin		-11A	69,70	18.0	0.312	2.311	2.2168	1.12	10.240
		-11B	71,72						
Center T-Stringer Continuous Skin		-1A	37,38	18.0	.188	.899	.4161	.5813	4.283
		-1B	41,42						
Center L-Stringer Continuous Skin		-3A	45,46	18.0	.188	.3383	.1365	.6227	3.722
		-3B	49,51						
Edge L-Stringer Continuous Skin		-5A	53,54	18.0	.188	1.382	1.2222	.917	6.148
		-5B	57,58						

*REF DWG GT221K0011

TABLE 8-2. STRINGER-REINFORCED SPECIMENS; SUMMARY OF TEST RESULTS

SPEC. ID	DASH NO.	SPEC. LOADING	MAX. STRESS (KSI)	MIN. STRESS (KSI)	LAST a_{cr} (IN)	MEASURE FAILURE a_{cr} (IN)	CYCLES TO FAILURE
37	-1A	C.A.	17.0	1.70	8.54	11.50	65,560
38	-1A	C.A.	17.0	1.70	9.85	11.00	66,080
39	-1A	A-10A	35.75	-8.34	1.93	4.30	208,093
40	-1A	A-10A	35.75	-8.34	3.58	3.70	174,486
41	-1B	C.A.	17.0	1.70	6.00	11.10	55,960
42	-1C	C.A.	17.0	1.70	7.50	10.55	74,330
43	-1B	A-10A	35.75	-8.34	4.10	5.20	201,407
44	-1B	A-10A	35.75	-8.34	4.10	5.20	202,880
45	-3A	C.A.	17.0	1.70	8.03	11.20	79,950
46	-3A	C.A.	17.0	1.70	9.34	12.25	72,100
47	-3A	A-10A	35.75	-8.25	2.65	5.40	255,661
48	-3A	A-10A	35.75	-8.25	1.65	9.50	224,761
49	-3B	C.A.	17.00	*	8.96	11.30	66,100
50	-3B	A-10A	28.0	-6.73	8.53	9.00	461,585
51	-3B	C.A.	17.00	1.70	8.05	11.80	79,700
52	-3B	A-10A	28.0	-6.73	5.00	9.70	688,165
53	-5A	C.A.	17.0	1.70	6.44	7.50	64,725
54	-5A	C.A.	17.0	1.70	8.95	12.90	69,547
55	-5A	A-10A	35.75	-8.34	0.729	3.10	100,823
56	-5A	A-10A	35.75	-8.34	2.070	5.00	160,900
57	-5B	C.A.	17.0	1.70	11.72	11.70	92,784
58	-5B	C.A.	17.0	1.70	12.89	13.50	82,509
59	-5B	A-10A	35.75	-8.34	0.77	3.50	173,913
60	-5B	A-10A	35.75	-8.34	3.06	3.10	130,030
61	-7A	AMAVS	30.5	-6.64	0.99	4.60	146,742
62	-7A	AMAVS	30.5	-6.64	0.553	2.80	544,007
63	-7B	AMAVS	30.5	-6.64	4.756	7.20	156,117
64	-7B	AMAVS	30.5	-6.64	5.204	6.50	204,191
65	-9A	AMAVS	30.35	-6.60	2.160	2.30	259,515
66	-9A	AMAVS	30.35	-6.60	5.499	6.50	101,023
67	-9B	AMAVS	30.35	-6.60	1.777	2.50	152,511
68	-9B	AMAVS	30.35	-6.60	1.099	1.80	176,213
69	-11B	AMAVS	21.48	-4.67	7.448	8.00	285,354
70	-11B	AMAVS	21.48	-4.67	1.719	5.80	234,218
71	-11A	AMAVS	21.48	-4.67	2.545	3.70	629,051
72	-11A	AMAVS	21.48	-4.67	2.690	2.40	441,256

*First 47,700 cycles $\sigma_{min} = 4.54$ KSI, subsequently $\sigma_{min} = 1.7$ KSI

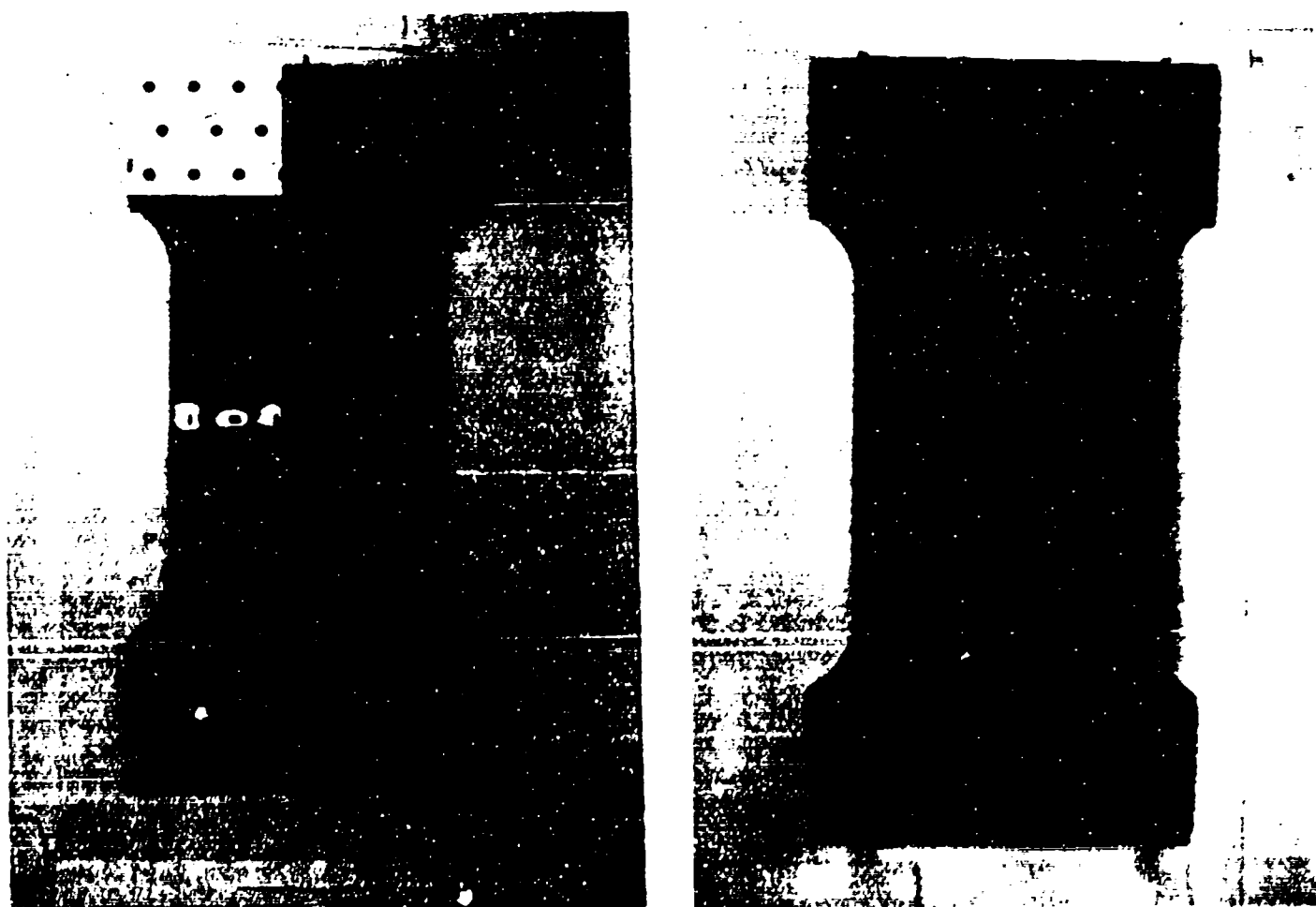
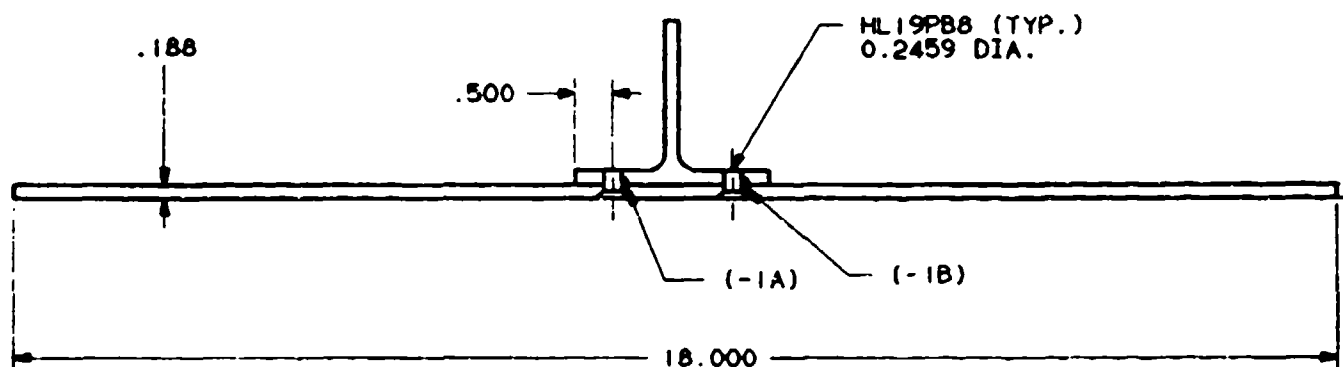


Figure 8-1. Photos of Stringer Reinforced Specimens

STRINGER

$$\bar{x} = 0.0$$

$$\bar{y} = 0.5813 \text{ in.}$$

$$I_{xx} = 0.4161 \text{ in.}^4$$

$$I_{yy} = 0.2890 \text{ in.}^4$$

$$A = 0.8990 \text{ in.}^2$$

SKIN + STRINGER

$$A = 4.28281 \text{ in.}^2$$

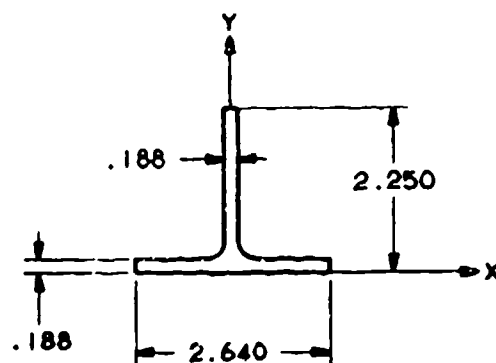
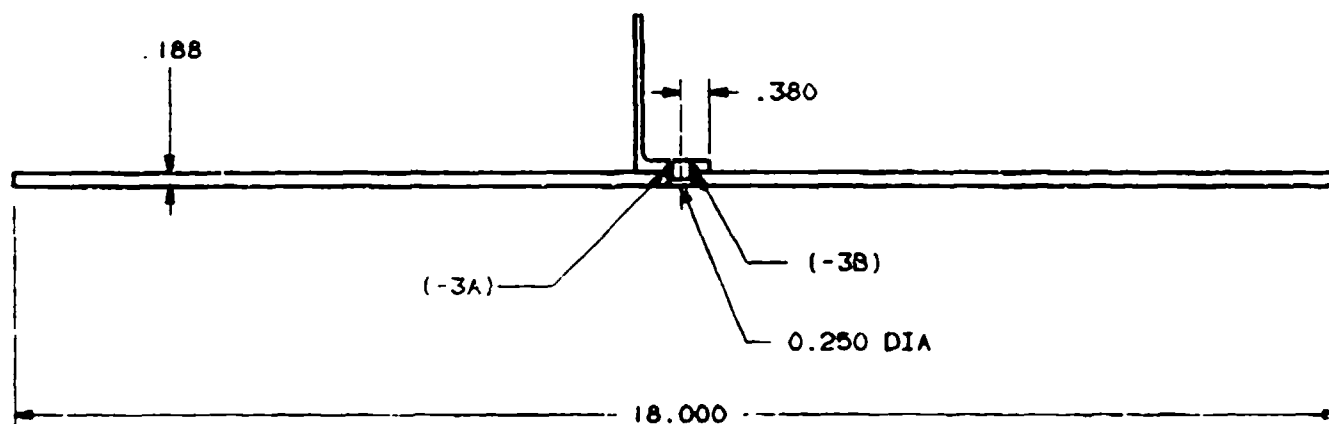


Figure 8-2. Specimen GT221K0011-1 Configuration

STRINGER

$$\bar{X} = 0.251 \text{ in.}$$

$$\bar{y} = 0.6227 \text{ in.}$$

$$I_{XX} = 0.1365 \text{ in.}^4$$

$$I_{YY} = 0.0292 \text{ in.}^4$$

$$A = 0.3383 \text{ in.}^2$$

SKIN + STRINGER

$$A = 3.7222 \text{ in.}^2$$

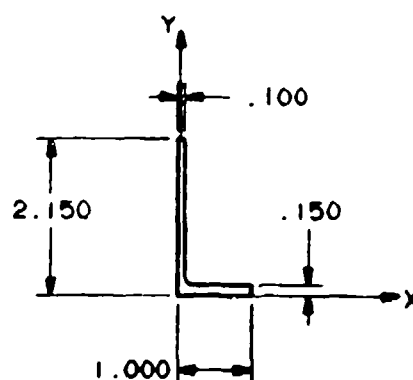
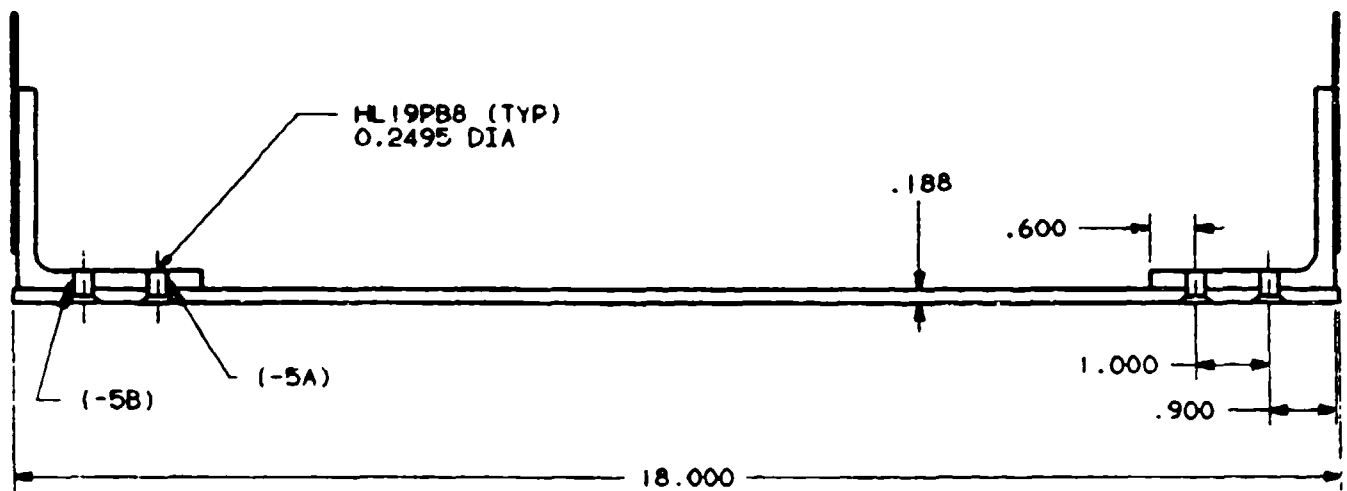


Figure 8-3. Specimen GT221K0011-3 Configuration

STRINGER

$$\bar{X} = 1.382 \text{ in.}^2$$

$$\bar{Y} = 1.852 \text{ in.}$$

$$I_{XX} = 0.593 \text{ in.}^4$$

$$I_{YY} = 0.868 \text{ in.}^4$$

$$A = 0.747 \text{ in.}^2$$

SKIN + STRINGER

$$A = 6.148 \text{ in.}^2$$

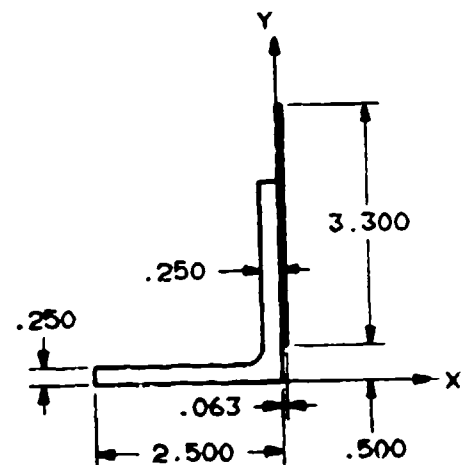
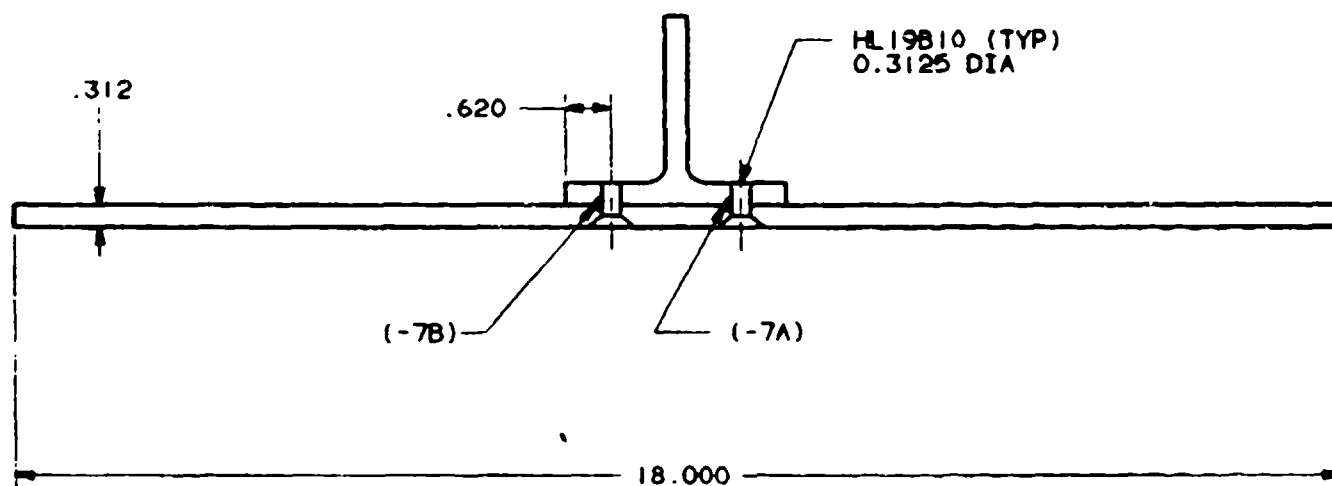


Figure 8-4. Specimen GT221K0011-5 Configuration

SPECIMEN NO. GT221K0011-7

MAT'L — 7075-T736/7075-T6



STRINGER

$$\bar{X} = 0.0$$

$$\bar{Y} = 0.7125 \text{ in.}$$

$$I_{XX} = 0.9719 \text{ in.}^4$$

$$I_{YY} = 0.6808 \text{ in.}^4$$

$$A = 1.5966 \text{ in.}^2$$

SKIN + STRINGER

$$A = 7.2124 \text{ in.}^2$$

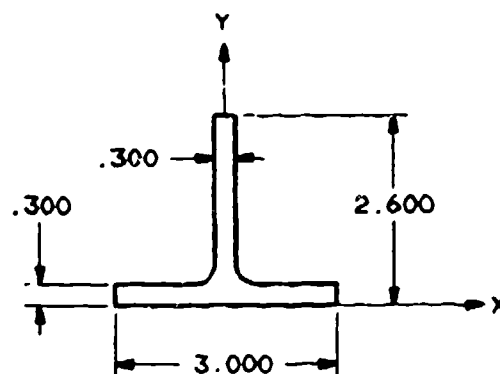
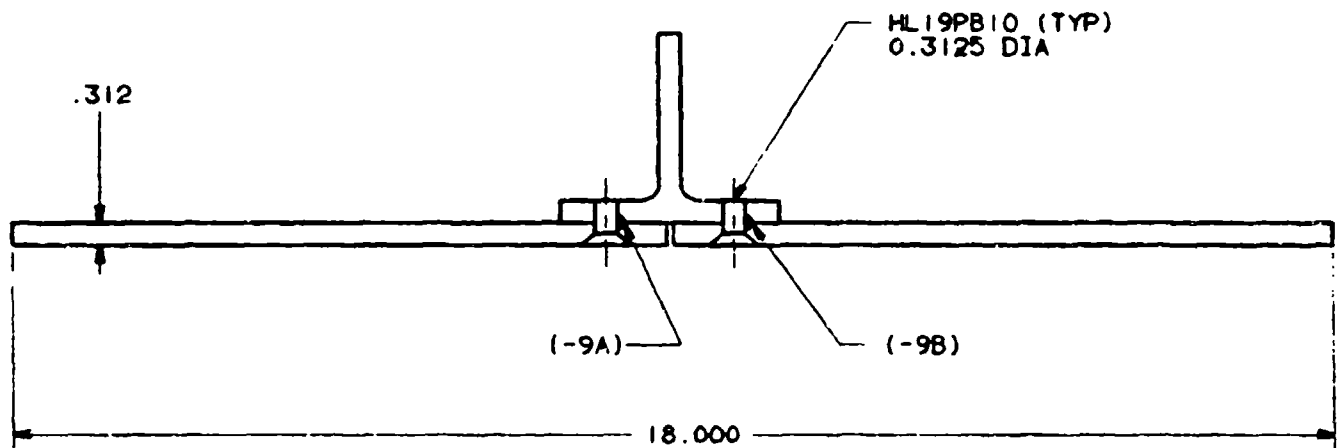


Figure 8-5. Specimen GT221K0011-7 Configuration

SPECIMEN NO. GT221K0011-9

MAT'L — 7075-T736/7075-T6



STRINGER

$$\bar{X} = 0.0$$

$$\bar{y} = 0.7125 \text{ in.}$$

$$I_{XX} = 0.9719 \text{ in.}^4$$

$$I_{YY} = 0.6808 \text{ in.}^4$$

$$A = 1.5966 \text{ in.}^2$$

SKIN + STRINGER

$$A = 7.18105 \text{ in.}^2$$

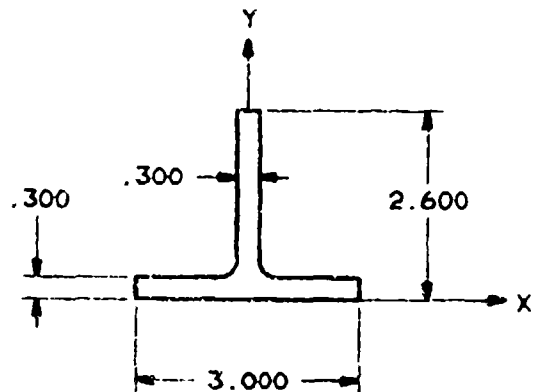
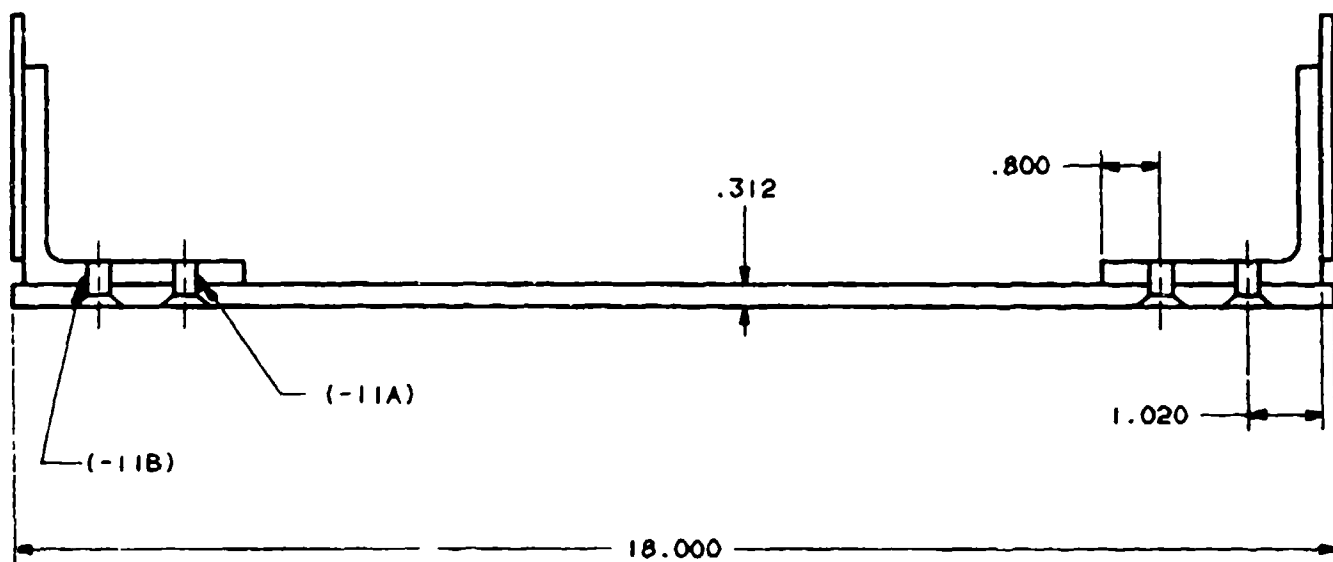


Figure 8-6. Specimen GT221K0011-9 Configuration

STRINGER

$$\bar{X} = 1.136 \text{ in.}$$

$$\bar{Y} = -0.643 \text{ in.}$$

$$I_{XX} = 1.8216 \text{ in.}^4$$

$$I_{YY} = 1.5693 \text{ in.}^4$$

$$A = 2.289 \text{ in.}^2$$

SKIN + STRINGER

$$A = 10.238 \text{ in.}^2$$

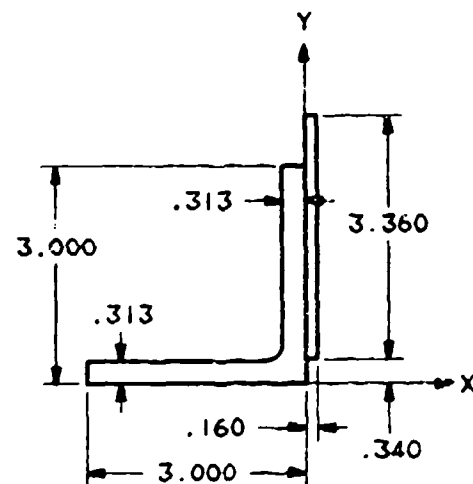


Figure 8-7. Specimen GT221K0011-11 Configuration



Figure 8-8. Specimen GT221K0011-1A Installed on MTS Testing Machine

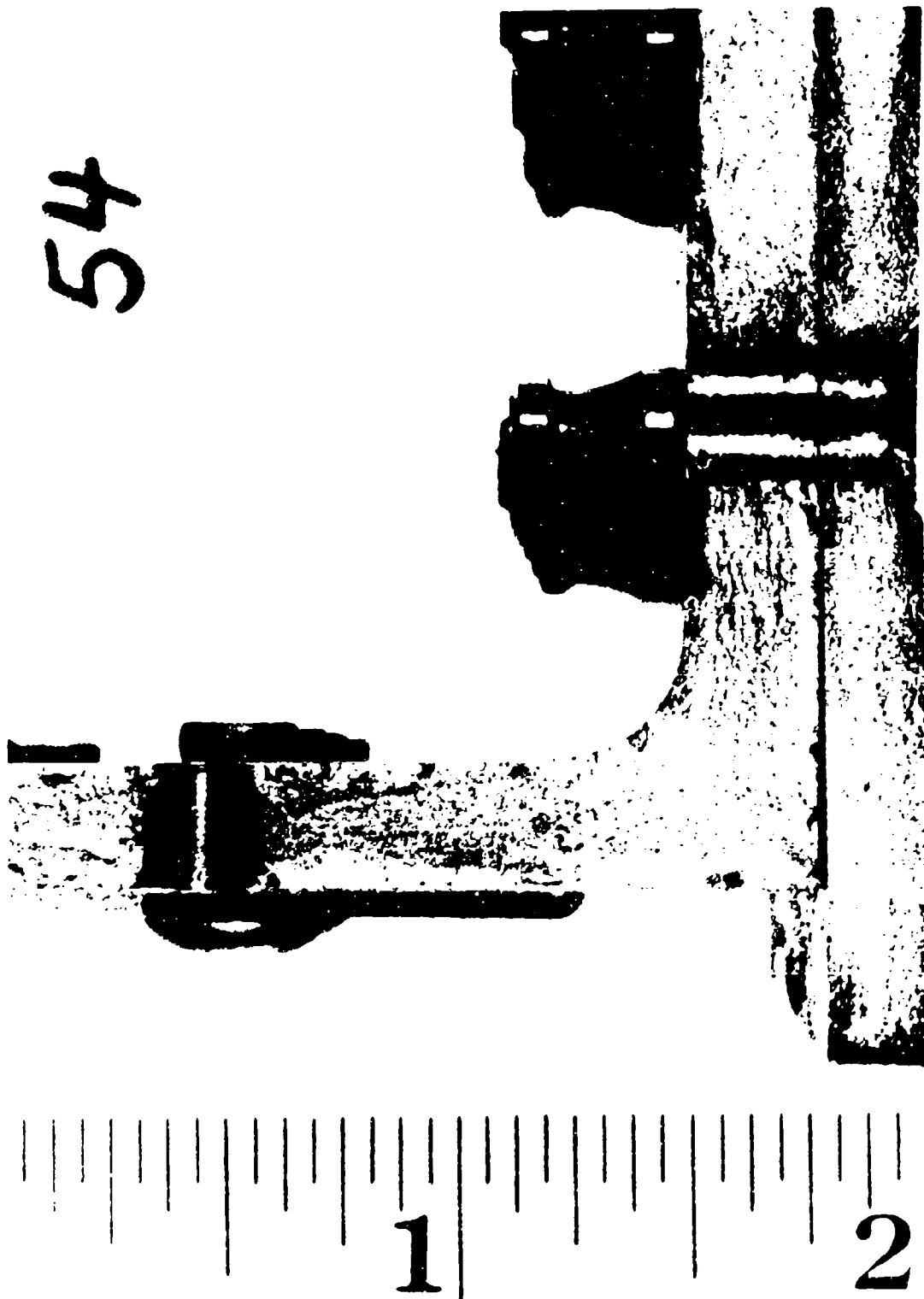


Figure 8-9. Specimen No. 54 Fracture Surface (Subjected to Constant Amplitude Loading)

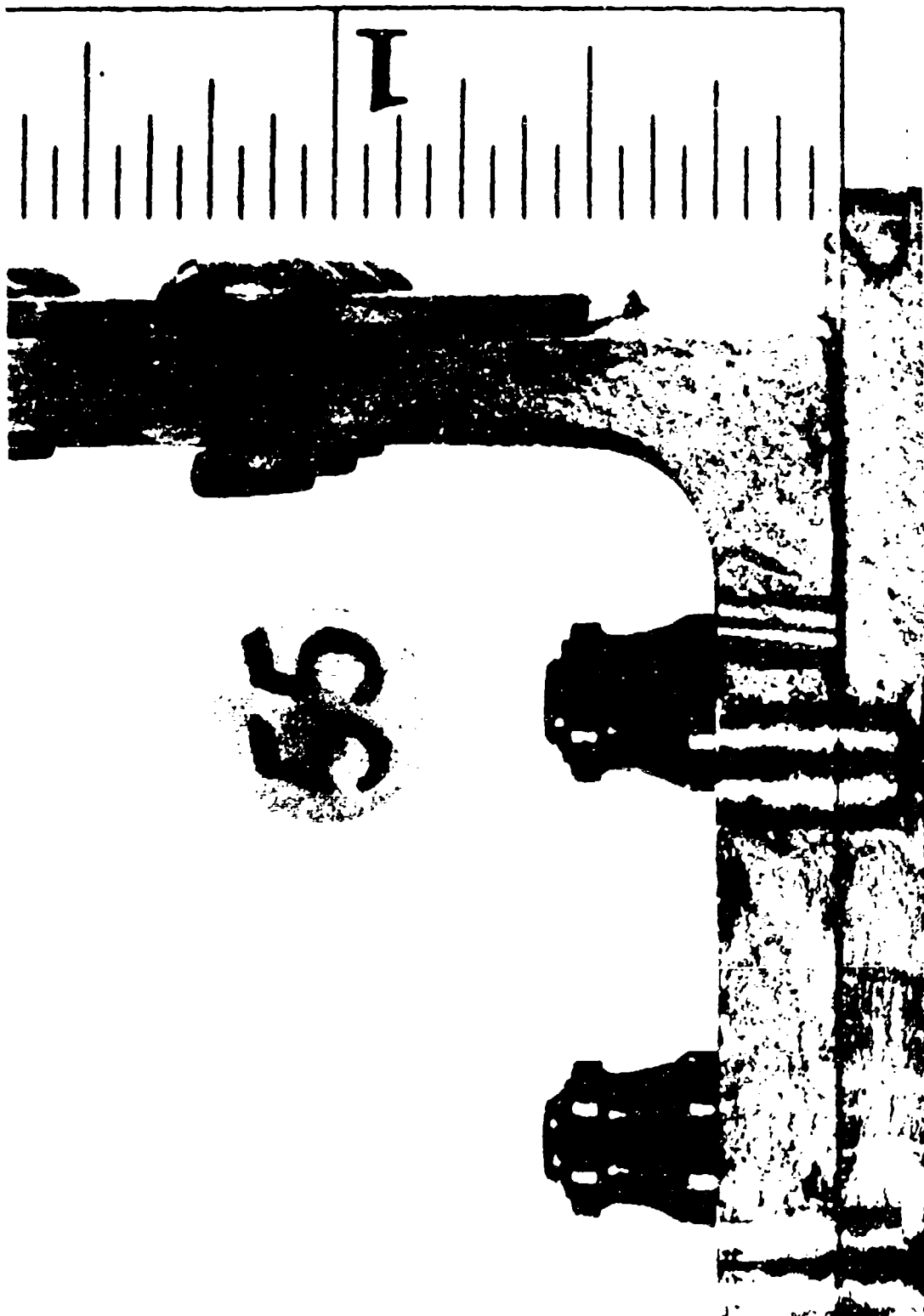


Figure 8-10. Specimen No. 55 Fracture Surface (Subjected to A-10A Loading Spectrum)

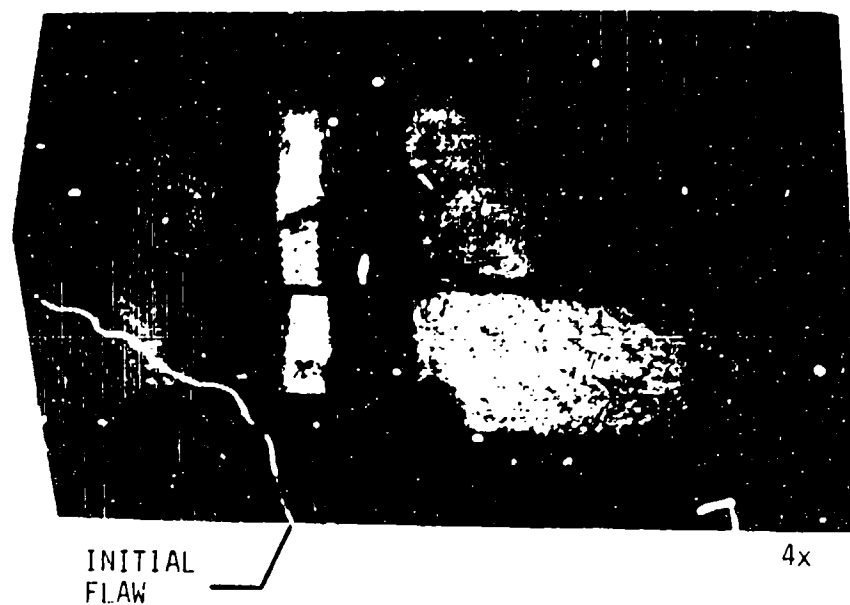
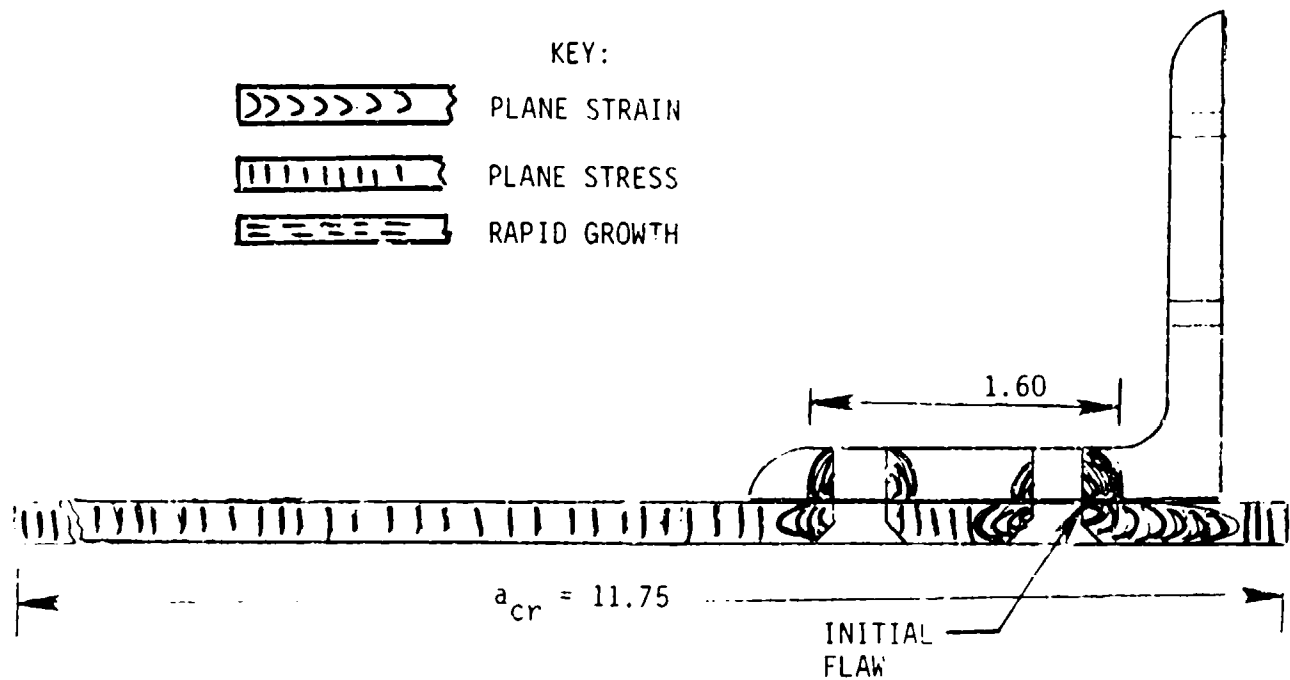


Figure 8-11A. Fractographic Examination of Specimen No. 57
(Subjected to C.A. Loading)

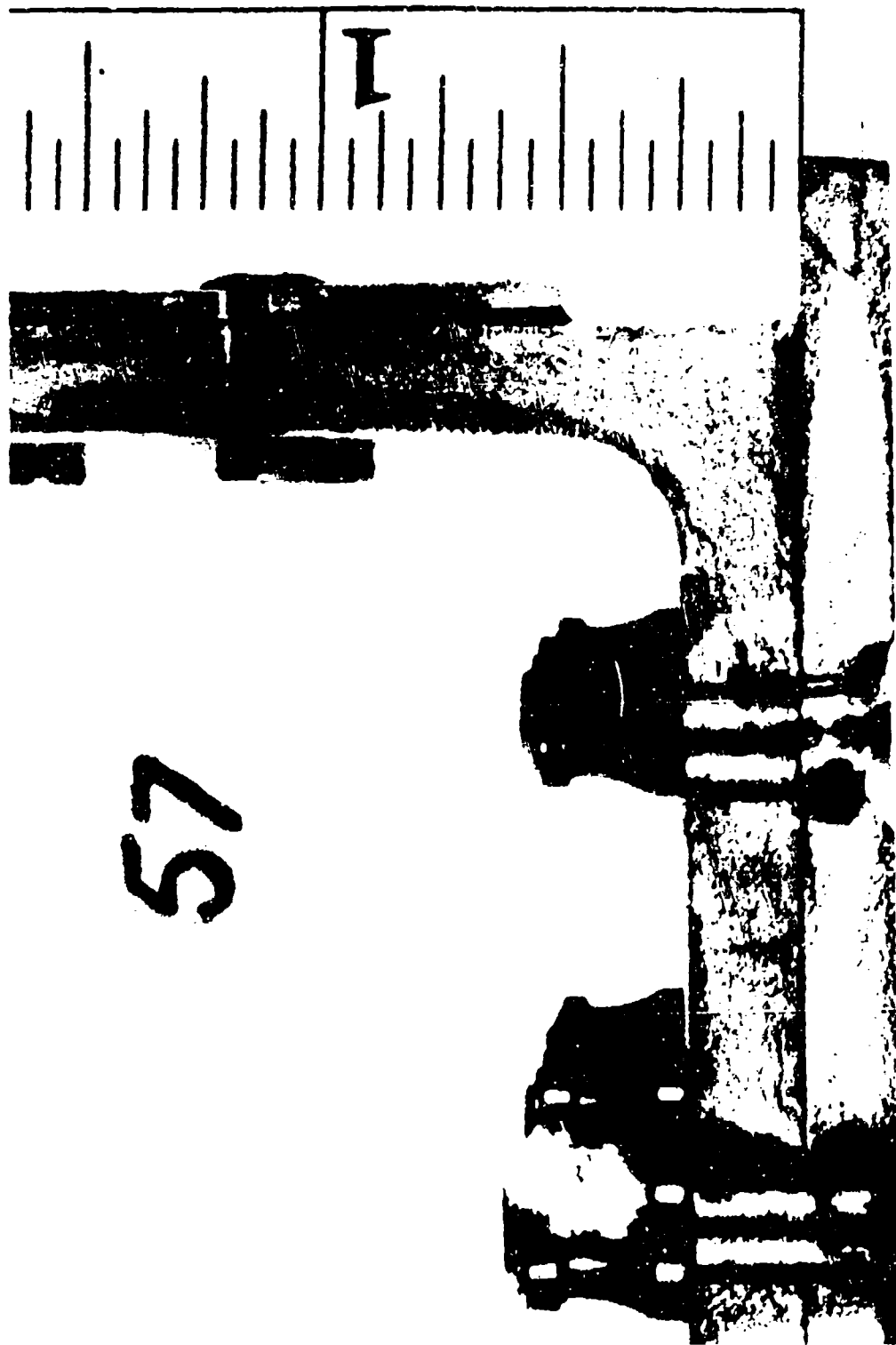


Figure 8-118. Specimen No. 57 Subsequent to Failure

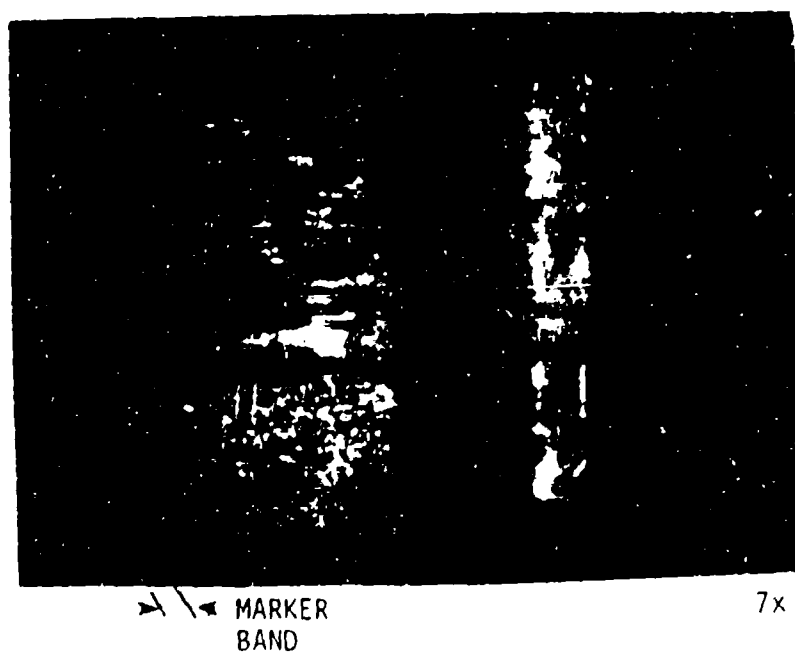
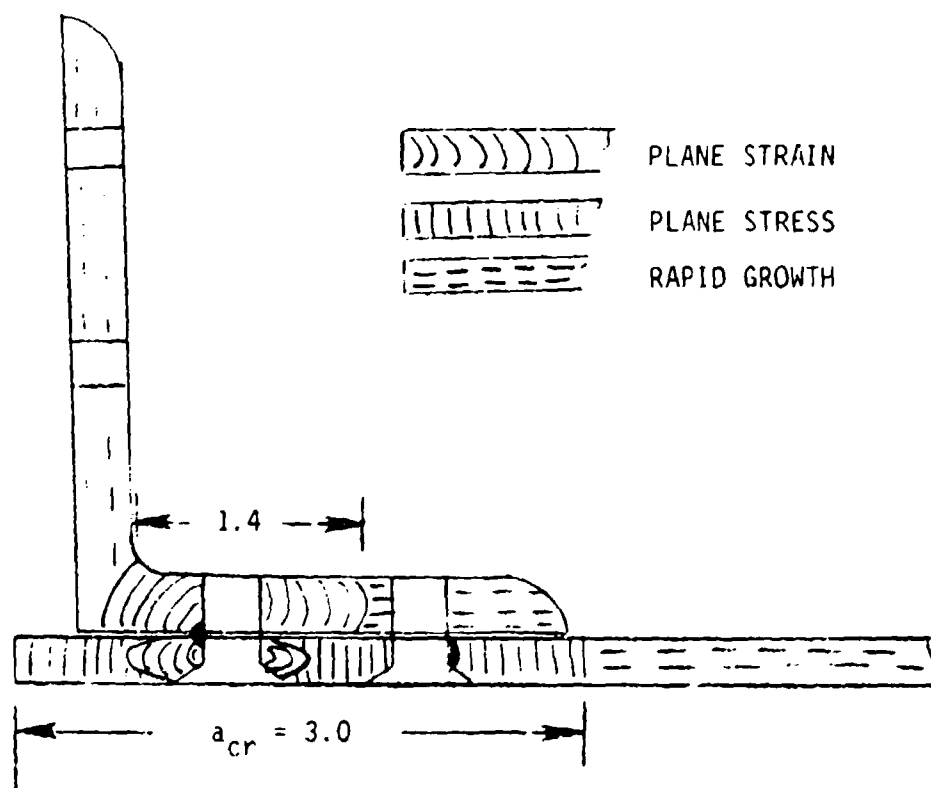


Figure 8-12A. Specimen No. 60 Fractographic Examination
(Subjected to A-10A Loading Spectrum)

60

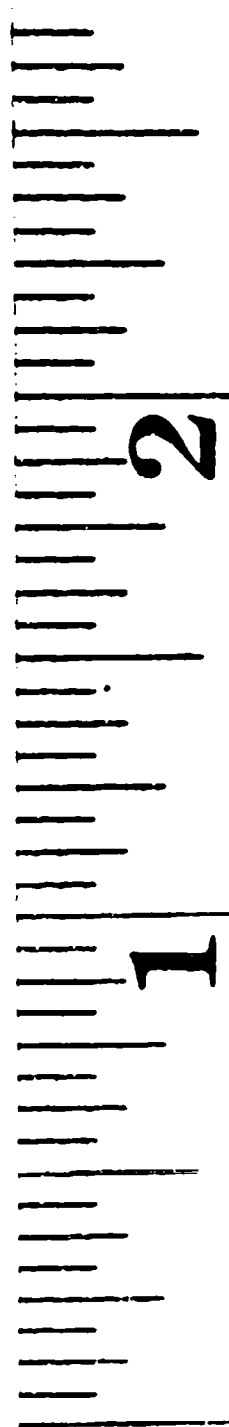
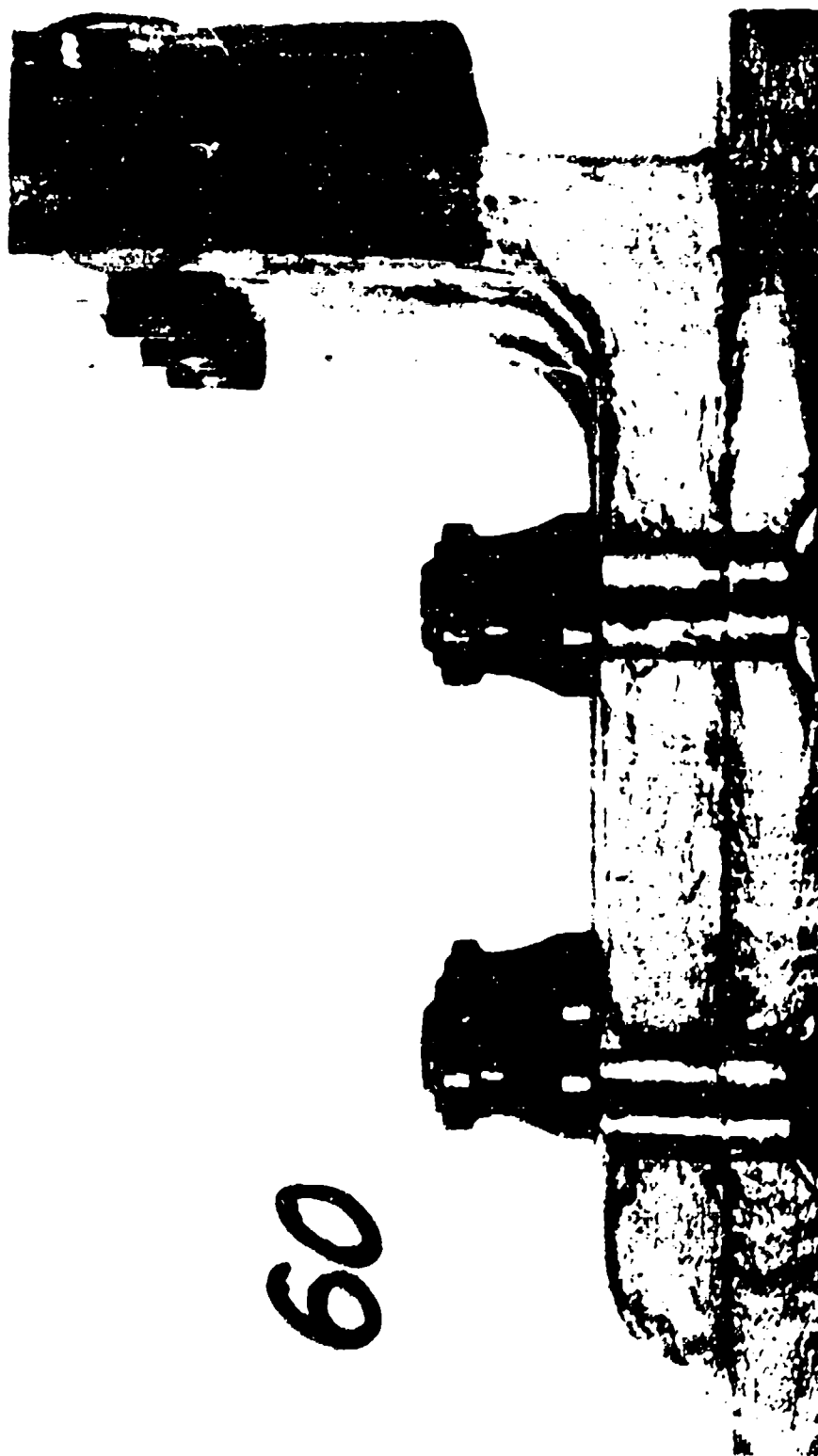


Figure 8-128. Specimen No. 60 Fracture Surface Subsequent to Failure

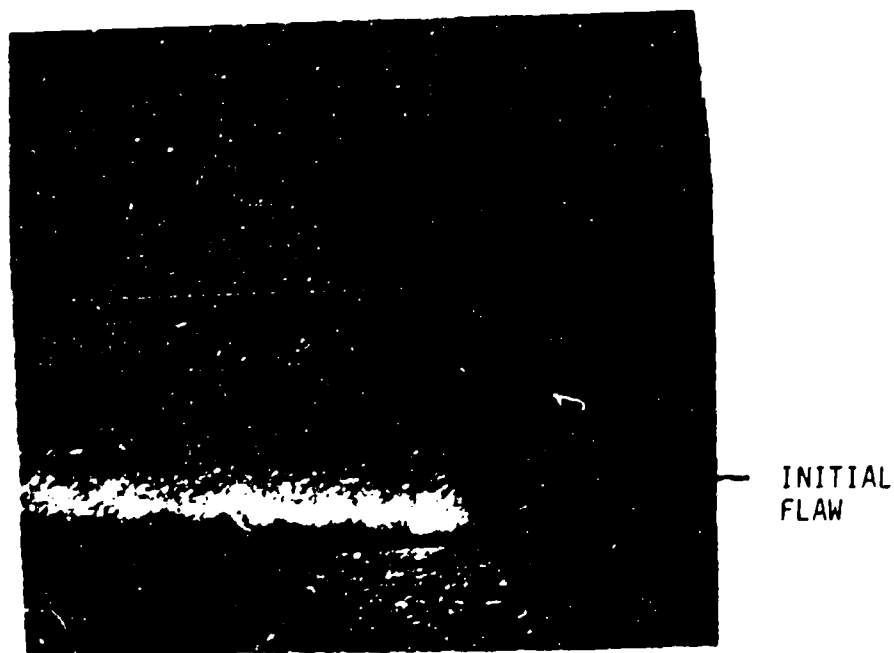
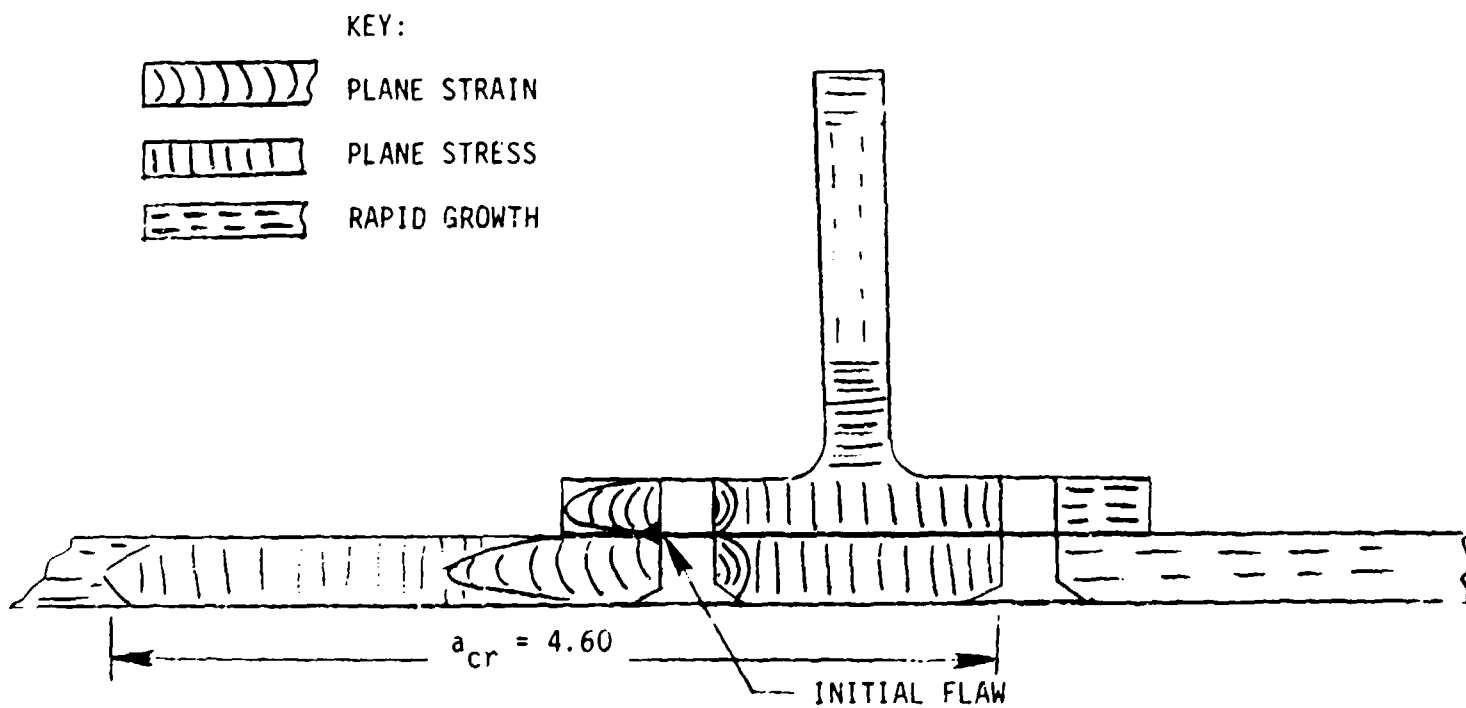


Figure 8-13A. Fractographic Examination of Specimen No. 63
(Subjected to AMAVS Loading Spectrum)

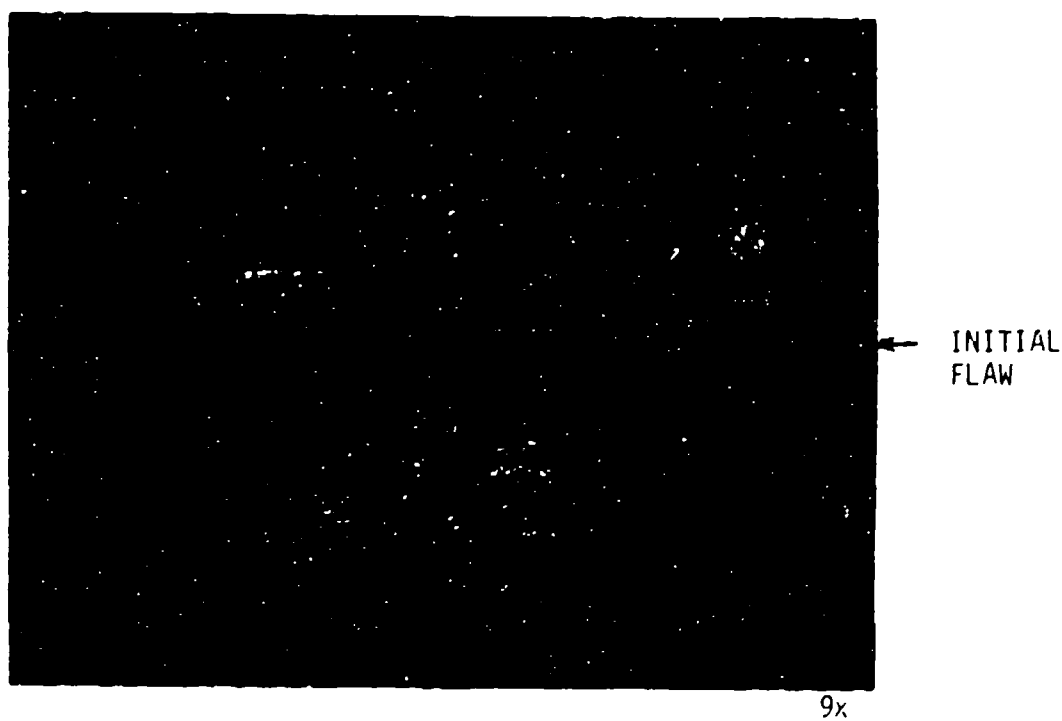
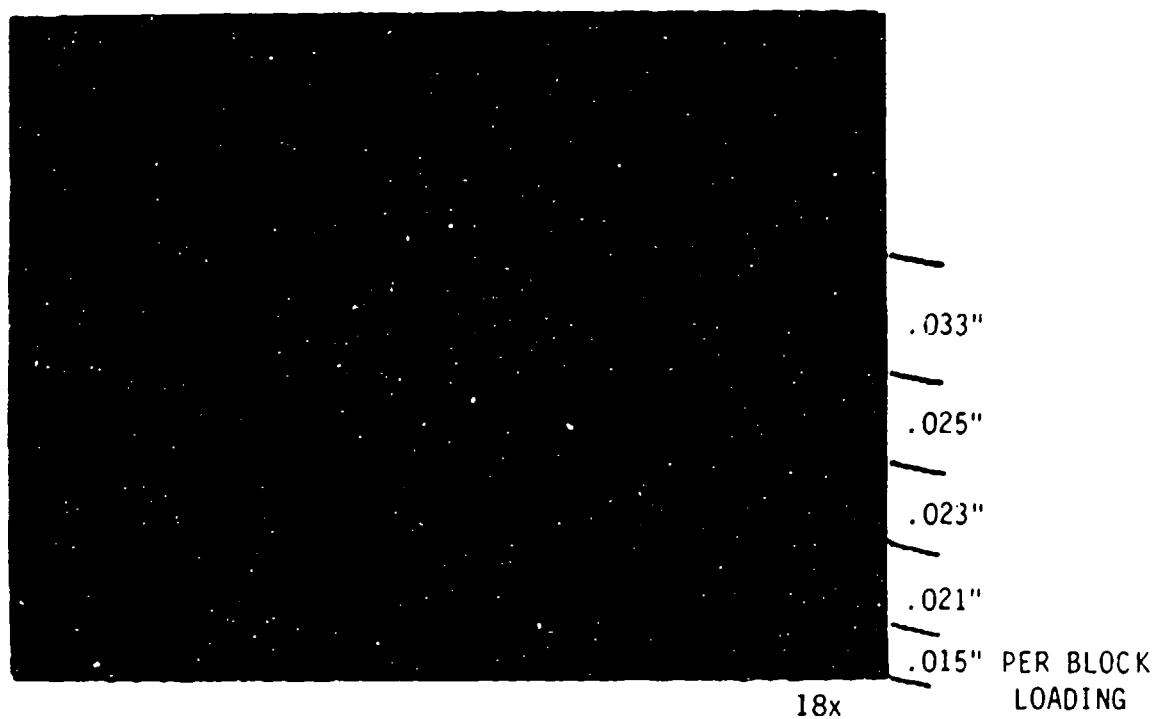


Figure 8-13B. Fractographic Examination of Specimen No. 63
(Subjected to AMAVS Loading Spectrum)

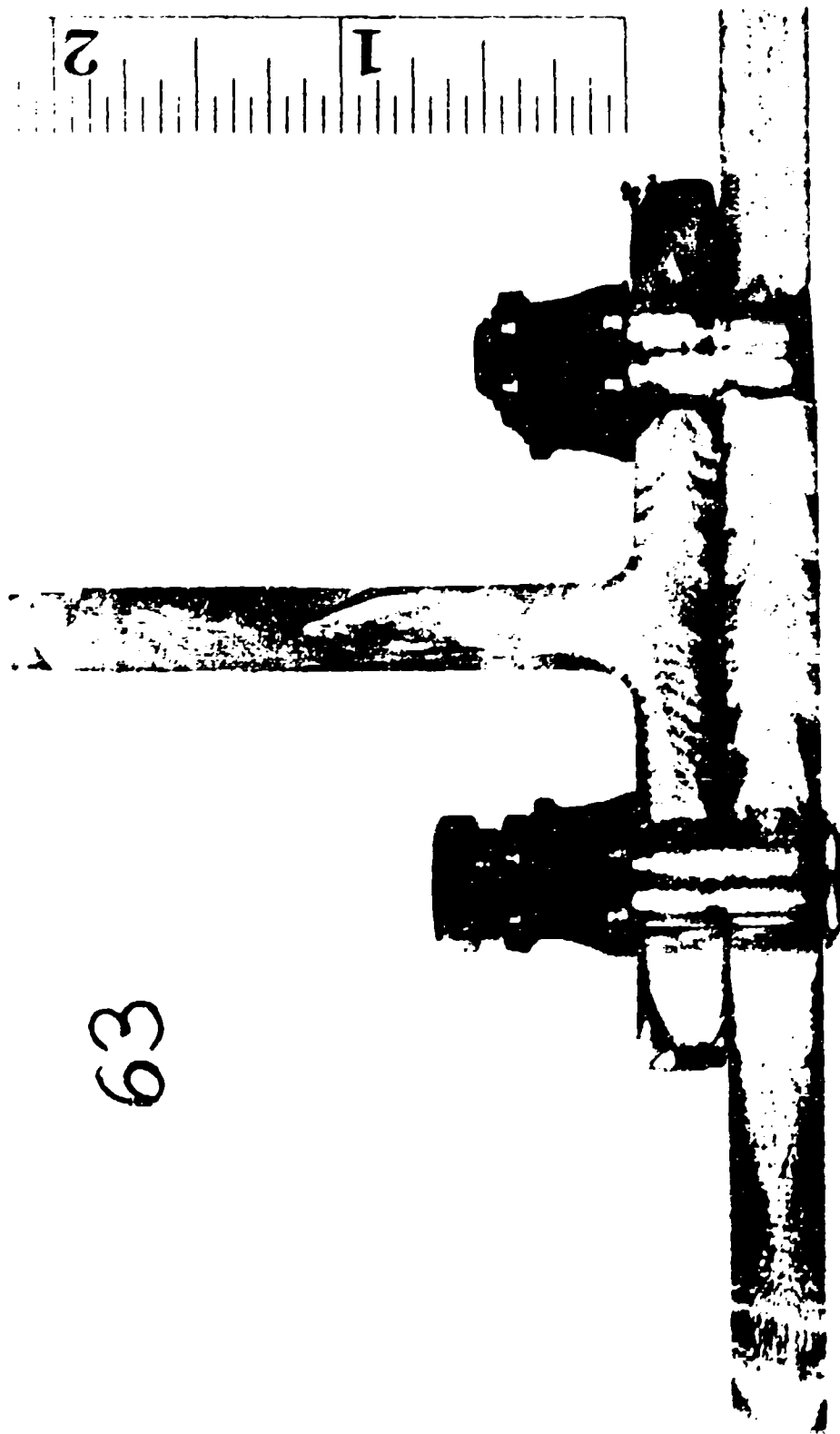
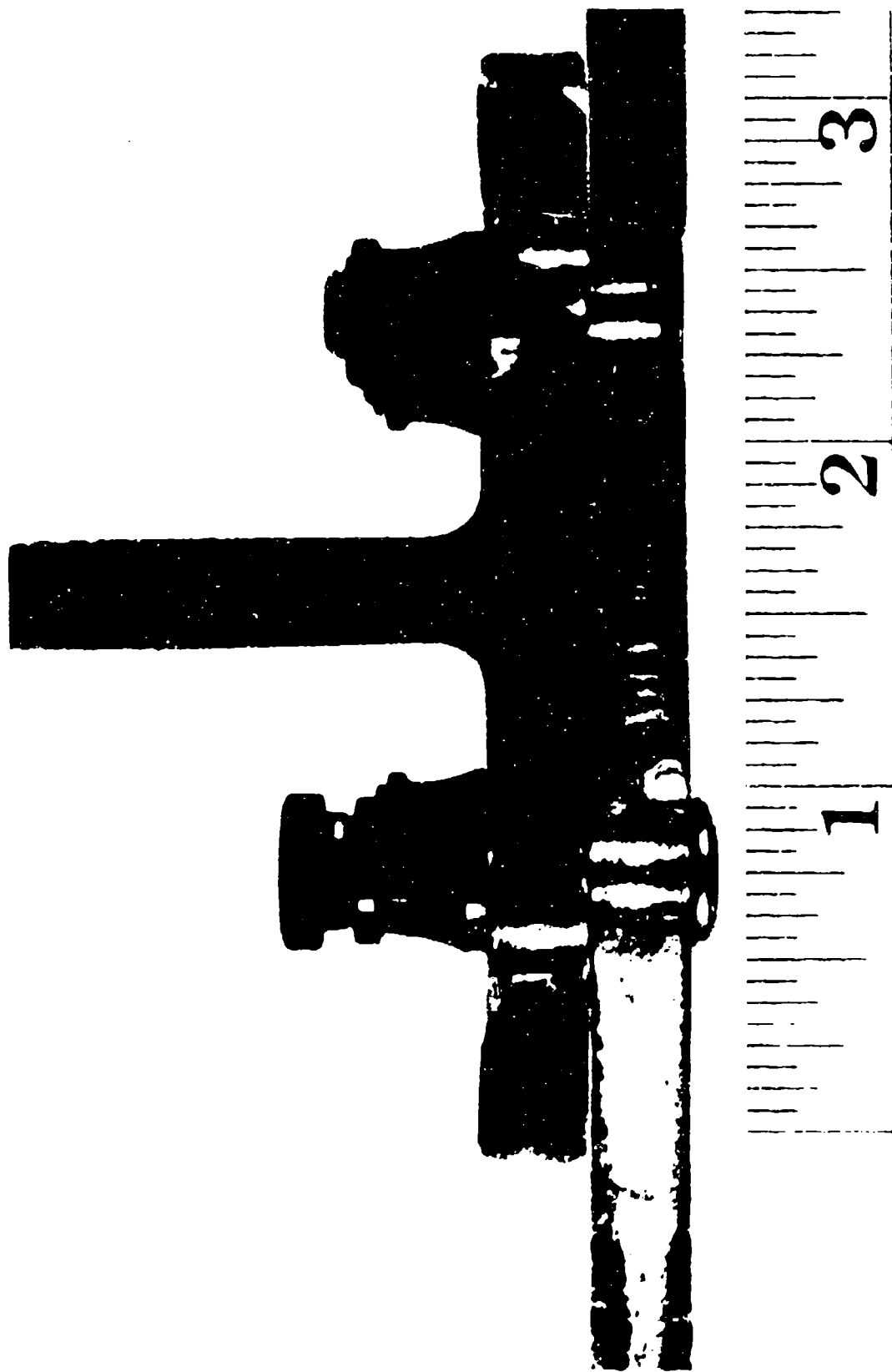


Figure 8-13C. Specimen No. 63 Fracture Surface Subsequent to Failure



64

Figure 8-14. Specimen No. 64 fracture Surface (Subjected to 'AMAVS' Loading Spectrum)

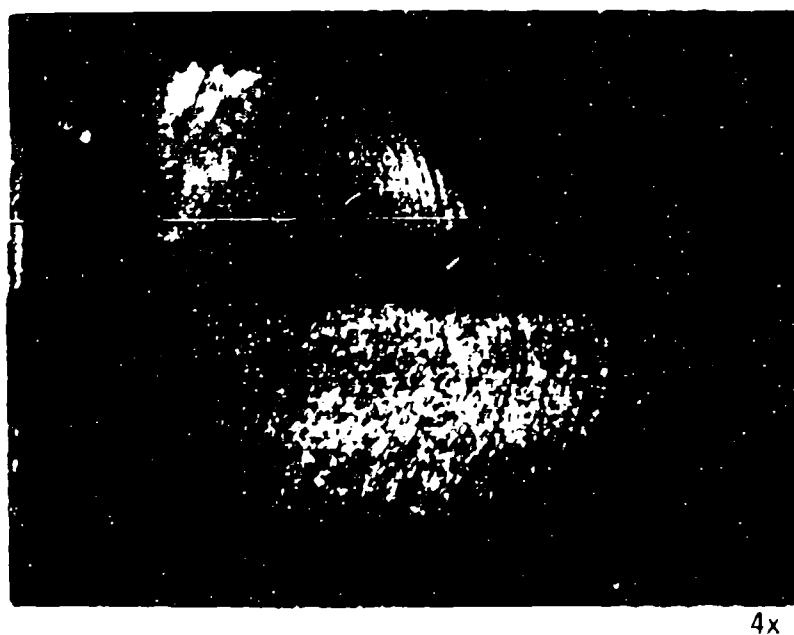
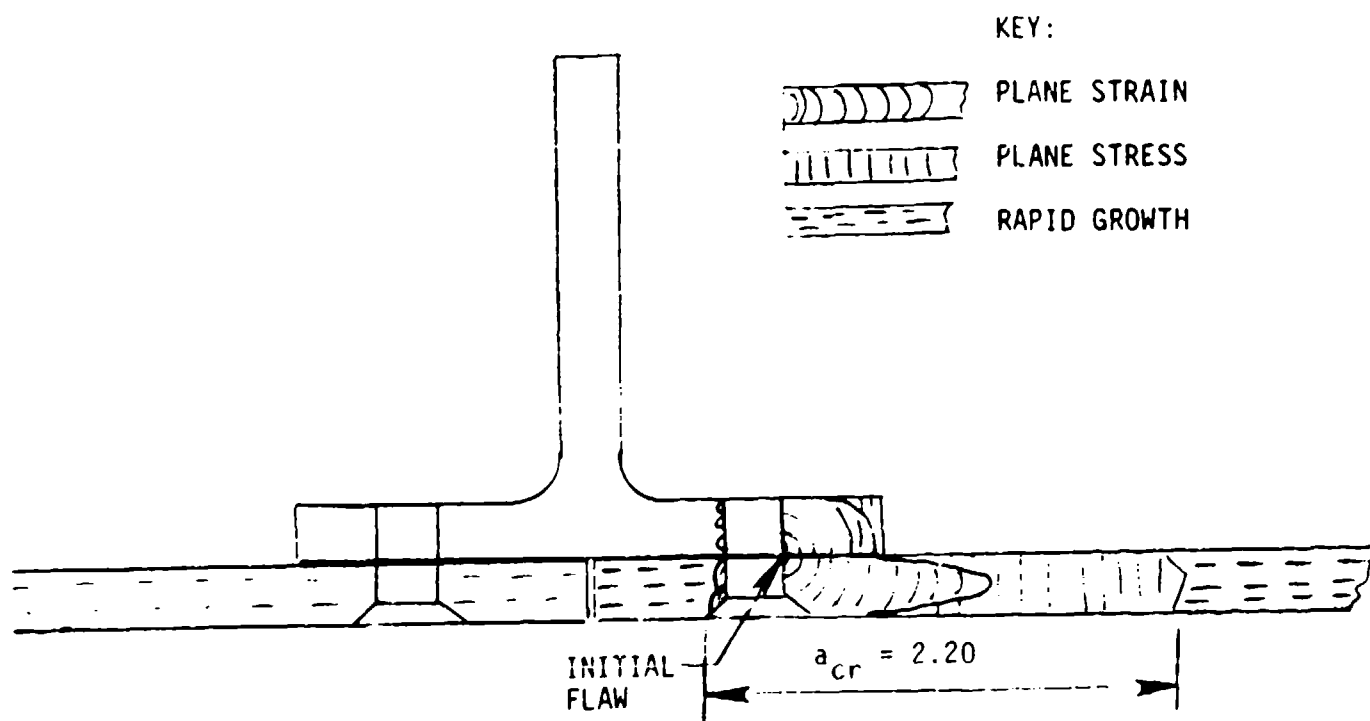


Figure 8-15A. Fractographic Examination of Specimen No. 67
(Subjected to AMAVS Loading Spectrum)

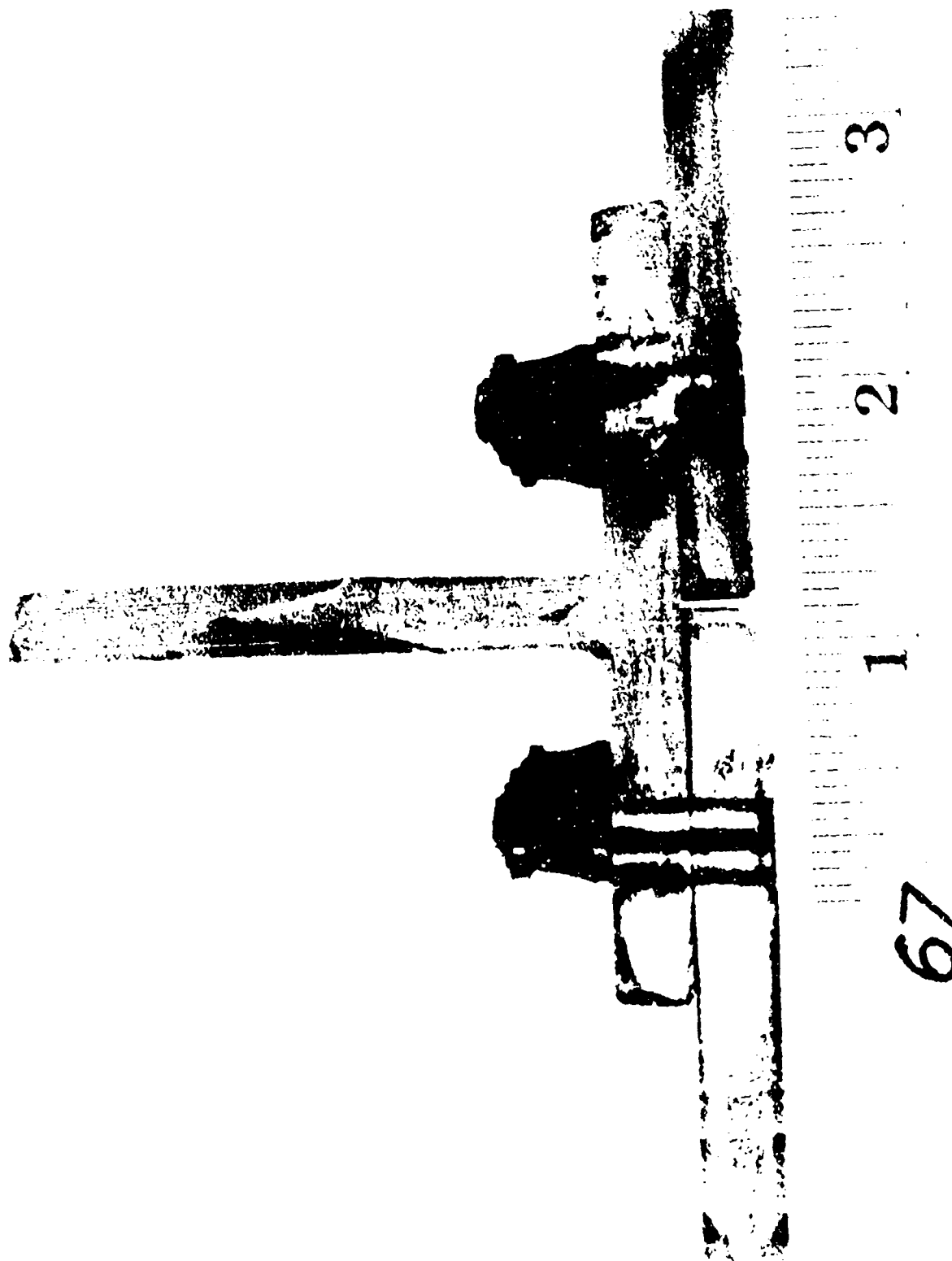


Figure 8-158. Specimen No. 67 Fracture Surface Subsequent to Failure



Figure 8-16. Specimen No. 70 Fracture Surface (Subjected 'AMVS' Loading Spectrum)

SPECIMEN NUMBER:	37	CYCLES TO FAILURE:	65560
SKIN/STRINGER:	S 1A S/N 1	% LIFE AT FAILURE:	
LOAD (KIPS):	72.80		
SPECTRUM:	CONSTANT AMP		
HOLE SIZE (INCHES):	0.256		

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TABLE 8-4. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 38

SPECIMEN NUMBER: 38
 SKIN/STRINGER: S-31 1A S/N 2 CVCLES TO FAILURE: 66030
 LOAD (KIPS): 72.80 % LIFE AT FAILURE:
 SPECTRUM: CONST AMP CRK LGTH AT FAIL: 11.00
 HOLE SIZE (INCHES): 0.256

CYCLES	NEW CRACK LENGTH				TOTAL CRACK LENGTH		
	SKIN		STRINGER		SKIN	SKIN	STRINGER
	R/FRONT	L/FRONT	R/BACK	L/BACK	FRONT	BACK	FRONT
0							
19400				0.000		0.425	
24400				0.169		0.448	
29400				0.192		0.525	
34000				0.269		0.603	0.360
39000				0.347		0.705	0.464
43000				0.449		0.805	0.520
47000				0.549		0.920	0.580
52000				0.672		1.073	0.685
56000				0.817		1.686	0.741
59520				1.430		2.047	0.774
62820			0.361	1.430	1.110	2.550	0.825
64290	0.854		0.864	1.430	1.631	3.255	1.529
64840	1.375		1.261	1.738	1.962	3.573	1.790
65130	1.706		1.578	1.739	2.232	3.856	1.923
65530	1.976		1.861	1.739	2.710	4.329	1.923
65830	2.454		2.334	1.739	3.193	4.824	2.332
65910	2.937		2.829	1.739	3.461	5.285	2.365
65950	3.205		3.081	1.948	5.972	5.740	FAILURE
65980	3.419	2.297	3.297	2.187	6.391	6.098	
66010	3.611	2.524	3.439	2.403	6.888	6.639	
66030	3.850	2.782	3.726	2.657	7.269	6.999	
66040	4.030	2.983	3.899	2.844	7.877	7.547	
66060	4.350	3.271	4.194	3.097	8.527	8.200	
66070	4.700	3.571	4.504	3.440	10.106	9.770	
66075	5.100	3.918	4.904	3.780	11.000	11.000	
66080	5.550	4.300	5.394	4.120			
	FAILURE	FAILURE	FAILURE	FAILURE			

SPECIMEN NUMBER:	39	CYCLES TO FAILURE:	208093
SKIN/STRINGER:	S-31 1A S/N 3	% LIFE AT FAILURE:	110
LOAD (KIPS):	153		
SPECTRUM:	A-10	FINAL CRACK LGTH:	4.30
HOLE DIA.(INCHES):	0.255		

CRACKS WERE NOT FOUND ON THE FRONT SKIN BECAUSE THEY WERE HIDDEN BY THE STRINGER

TABLE 8-6. STRAIN SURVEY OF SPECIMEN NO. 40

CYCLES TO FAILURE: 174486
APPLIED LOAD(LBS): 63750

A-10
3.7

SPECTRUM:
FINAL CRACK LGTH:

SPECIMEN NUMBER: 40
SPECIMEN TYPE: CENTER T

CYCLES	% OF LIFE	SKIN CRACK LENGTH	STRINGER CRACK LENGTH	GAGE 1 L/F	GAGE 2 L/F	GAGE 3 S/R	STRAIN			MICROINCHES / INCH			GAGE 8 L/B	GAGE 11
							GAGE 4 R/F	GAGE 5 R/F	GAGE 6 R/B	GAGE 7 C/B	GAGE 9	GAGE 10		
0	0	0.000	0.000	1247	1321	1202	1397	1504	1401	1351	1347			
7717	4	0.000	0.000	1273	1335	1102	1424	1566	1443	1349	1356			
15435	8	0.000	0.000	1277	1339	1101	1429	1573	1450	1349	1361			
23155	12	0.000	0.000	1276	1341	1097	1430	1574	1452	1349	1360			
30874	16	0.000	0.000	1274	1341	1095	1431	1574	1453	1350	1359			
38590	20	0.000	0.000	1273	1341	1094	1432	1576	1453	1350	1359			
46313	24	0.000	0.000	1272	1342	1094	1434	1579	1456	1352	1359			
53044	28	0.000	0.000	1290	1347	1075	1439	1591	1459	1349	1362			
60766	32	0.000	0.000	1277	1347	1101	1442	1591	1464	1366	1364			
68486	36	0.000	0.000	1301	1367	1120	1466	1619	1487	1393	1386			
76205	40	0.000	0.279	1269	1336	1084	1439	1582	1461	1373	1356			
83922	44	0.361	0.332	1260	1330	1073	1436	1573	1457	1378	1348			
91646	48	0.388	0.358	1282	1335	1075	1497	1579	1465	1399	1352			
98376	52	0.417	0.377	1291	1342	1051	1516	1589	1466	1413	1351			
106094	56	0.441	0.385	1284	1335	1059	1571	1577	1470	1436	1351			
113813	60	0.469	0.407	1283	1335	1071	1540	1571	1473	1467	1350			
121534	64	0.501	0.429	1294	1334	1053	1563	1575	1489	1531	1349			
129252	68	0.700	0.442	1293	1334	1045	1580	1604	1508	1618	1348			
136974	72	0.757	0.465	1304	1337	1035	1621	1729	1542	1776	1351			
143704	76	0.832	0.481	1294	1346	1005	1680	1660	1579	1985	1345			
151424	80	0.901	0.595	1294	1347	1000	1654	1745	1654	2409	1351			
159144	84	0.996	0.783	1292	1356	924	1810	1746	1836	3424	1341			
163254	86	1.079	1.103	1293	1363	799	1987	1764	2114	4617	1360			
166861	88	1.238	1.143	1305	1431	606	2687	1870	3212	10096	1450			
170972	90	1.585	1.143	1310	1507	284	4456	1987	5672	OFFSCALE	1614			
174310	92	3.576	2.236	2298	9551	1934	OFFSCALE	3569	OFFSCALE	OFFSCALE	3749			
174566	92	FAILURE	FAILURE											

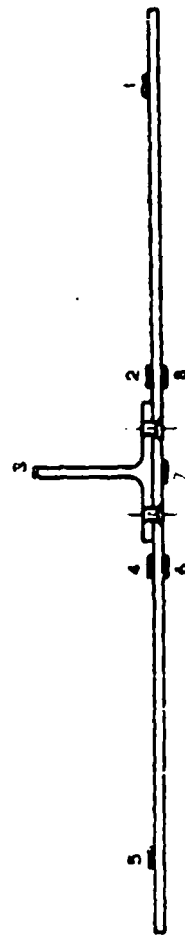


TABLE 8-7. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 40

SPECIMEN NUMBER: 40
 SKIN/STRINGER: S-31 1A S/N 4
 LOAD (KIPS): 153
 SPECTRUM: A-10
 HOLE DIA (INCHES): 0.249
 CYCLES TO FAILURE: 174486
 % LIFE AT FAILURE: 92
 FINAL CRACK LGTH: 3.70

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		SKIN		S' STRINGER		TOTAL SKIN	CRACK		LENGTH
					R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT		SKIN BACK	SKIN FRONT	
0	0	0	0	0							0.249	0.249	0.249	0.249
1	10	61	40	76205						0.030	0.249	0.249	0.249	0.279
1	11	61	44	83922			0.112			0.083	0.249	0.361	0.332	0.332
1	12	61	48	91616			0.139			0.105	0.249	0.388	0.358	0.358
1	13	61	52	98376			0.168			0.128	0.249	0.417	0.377	0.377
1	14	61	56	106094			0.192			0.136	0.249	0.441	0.365	0.365
1	15	61	60	113813			0.220			0.158	0.249	0.469	0.407	0.407
1	16	61	64	121534			0.252			0.180	0.249	0.501	0.429	0.429
1	17	61	60	129252			0.297	0.154		0.193	0.249	0.700	0.442	0.442
1	18	61	72	136374			0.318	0.190		0.216	0.249	0.757	0.465	0.465
1	19	61	76	143704			0.348	0.235		0.232	0.249	0.832	0.481	0.481
1	20	61	80	151424			0.385	0.267	0.070	0.276	0.249	0.901	0.595	0.595
1	21	61	84	159144			0.431	0.316	0.157	0.377	0.249	0.996	0.783	0.783
1	22	16	85	161199			0.452	0.343	0.253	0.419	0.249	1.044	0.921	0.921
1	22	32	86	163254			0.462	0.368	0.383	0.471	0.249	1.079	1.103	1.103
1	27	48	87	165310			0.515	0.403	FAILURE	0.511	0.249	1.167	0.760	0.760
1	22	61	88	166861		0.412	0.569	0.420		0.511	0.661	1.238	0.760	0.760
1	23	16	89	168797	0.474		0.611	0.511	FAILURE	0.511	0.723	1.371	0.760	0.760
1	23	32	90	170972	0.580		0.745	0.591		0.511	0.837	1.585	0.760	0.760
1	23	48	91	173027	0.722		0.915	0.735		0.511	0.971	1.899	0.760	0.760
1	23	58	92	174310	1.345		1.979	1.348		1.987	1.594	3.576	2.236	2.236
1	23	60	92	174486	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	3.700	3.700	FAILURE	FAILURE
1											0.249	0.249	0.249	0.249

TABLE 8-8. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 41

SPECIMEN NUMBER: 41
 SKIN/STRINGER: S-31 LB S/N 1
 LOAD: RTFP, 72.80
 SPECTRUM: CONST AMP
 HOLE SIZE(INCHES): 0.266
 CYCLES TO FAILURE: 55960
 % LIFE AT FAILURE:
 CRK LGTH AT FAIL: 10.55

CYCLES	NEW CRACK LENGTH				TOTAL CRACK LENGTH			
	SKIN R/FRONT	SKIN L/FRONT	SKIN R/BACK	SKIN L/BACK	STRINGER R/FRONT	STRINGER L/FRONT	SKIN FRONT	SKIN STRINGER BACK FRONT
0							0.266	0.266
21990				0.000	0.000		0.266	0.266
22440				0.138	0.031		0.266	0.266
23130				0.169	0.065		0.266	0.297
24280				0.161	0.094		0.266	0.331
25130				0.179	0.117		0.266	0.360
25530				0.197	0.141		0.266	0.383
26100				0.207	0.166		0.266	0.407
27330				0.222	0.194		0.266	0.432
28406				0.241	0.217		0.266	0.460
29243				0.262	0.242		0.266	0.483
30140				0.268	0.266		0.266	0.508
30470				0.299	0.300		0.266	0.532
30600				0.305	0.336		0.266	0.566
31500				0.308	0.368		0.266	0.602
32080				0.339	0.368		0.266	0.634
32640				0.365	0.368		0.266	0.634
33040	0.458			0.460	0.368		0.724	0.634
34620	0.555			0.565	0.368		0.821	0.634
44060	0.649			0.665	0.368		0.915	0.634
44860	0.752			0.765	0.368		1.018	0.634
46550	0.845			0.865	0.368		1.111	0.634
51170	1.221		0.162	1.231	0.368		1.487	0.634
53040	1.531		0.438	1.559	0.368	0.254	1.797	0.888
55680	2.937		1.282	2.076	0.368	1.001	3.203	1.635
55950	3.488	2.233	2.253	3.496	0.368	1.001	5.987	1.635
55960	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE

STRINGER CRACK REACHED THE RIGHT EDGE AT CYCLE 30600

TABLE 8-9. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 42

SPECIMEN NUMBER: 42		CYCLES TO FAILURE: 74330				
SKIN/STRINGER: S-31 1B S/N 2		% LIFE AT FAILURE:				
LOAD(LIFE): 72.80						
SPECTRUM: CONST AMP		CRK LGTH AT FAIL: 10.55				
HOLE SIZE(INCHES): 0.263						
CYCLES	SKIN		NEW CRACK LENGTH		TOTAL CRACK LENGTH	
	R/FRONT	L/FRONT	R/DACK	L/BACK	SKIN FRONT	SKIN STRINGER BACK FRONT
23530				0.041		0.304
28530				0.084		0.347
33530				0.211		0.474
38530				0.292		0.555
43530	0.390			0.380	0.025	0.643
48530	0.439			0.504	0.025	0.767
53530	0.606			0.605	0.062	0.869
58560	0.751			0.745	0.142	0.868
63640	0.977		0.183	0.965	0.236	1.000
66470	1.192		0.452	1.190	0.370	1.411
68500	1.459		0.715	1.450	0.370	1.905
69930	1.710		1.007	1.716	0.370	1.722
70500	1.841		1.233	1.862	0.370	2.436
70960	2.005		1.295	2.017	0.370	1.973
71850	2.208		1.295	2.265	0.370	2.906
72430	2.544		1.295	2.536	0.370	3.358
72900	2.872		1.295	2.869	0.370	3.575
73430	3.373		1.295	3.372	0.407	3.823
73860	3.800		1.295	3.801	0.535	4.094
74140	4.400		1.295	4.389	0.700	4.427
74280	5.007	2.221	2.273	5.094	0.370	4.930
74330	FAILURE	FAILURE	FAILURE	FAILURE	0.370	5.439
					1.087	1.333
					1.316	1.720
					7.491	1.949
					FAILURE	FAILURE
					FAILURE	FAILURE

LEFT STRINGER CRACK OF .7 IS AN ESTIMATED VALUE

STRINGER BROKE FIRST THEN TOTAL FAILURE

TABLE 8-10. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 43

SPECIMEN NUMBER: 43 SKIN/STRINGER: S-31 1B S/N 3 LOAD (KIPS): 153 SPECTRUM: A-10 HOLE DIA (INCHES): 0.262										CYCLES TO FAILURE: & LIFE AT FAILURE:		FINAL CRACK LGTH:	
										201407		5.20	
LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN R/FRONT	SKIN L/FRONT	SKIN R/BACK	SKIN L/BACK	STRINGER R/FRONT	STRINGER L/FRONT	TOTAL SKIN FRONT	CRACK SKIN BACK	LENGTH STRINGER FRONT
0	0	0	0	0					0.000	0.000	0.262	0.262	0.262
1	9	61	36	68218					0.026	0.020	0.262	0.262	0.316
1	10	61	40	75906					0.032	0.019	0.262	0.262	0.313
1	11	61	44	83592					0.077	0.020	0.262	0.262	0.359
1	12	61	48	91285					0.091	0.020	0.262	0.262	0.373
1	13	61	52	97989					0.104	0.020	0.262	0.262	0.386
1	14	61	56	105678					0.119	0.020	0.262	0.262	0.401
1	15	61	60	113368				0.144	0.141	0.020	0.262	0.406	0.423
1	16	61	64	121058				0.173	0.172	0.020	0.262	0.435	0.454
1	17	61	68	128746				0.203	0.202	0.020	0.262	0.465	0.484
1	18	61	72	136440				0.231	0.264	0.035	0.262	0.493	0.561
1	19	61	76	143146				0.255	0.302	0.100	0.262	0.517	0.752
1	20	61	80	150037				0.292	0.303	0.247	0.262	0.554	0.892
1	21	61	84	158527			0.154	0.334	0.303	0.371	0.262	0.750	1.016
1	22	61	88	166216			0.198	0.375	0.303	0.427	0.262	0.835	1.072
1	23	61	92	173903			0.247	0.424	0.407	0.476	0.262	0.933	1.145
1	24	61	96	181598			0.295	0.479	0.453	0.509	0.262	1.036	1.224
1	25	61	100	188302			0.354	0.541	0.510	0.515	0.262	1.157	1.287
2	1	61	104	195990			0.472	0.659	0.630	0.558	0.262	1.393	1.450
2	2	38	106	200960			N/A	N/A	FAILURE	FAILURE	N/A	N/A	0.262
2	2	39	107	201033		1.854	1.957	1.835			4.105	4.054	0.262
2	2	43	107	201407	FAILURE	FAILURE	FAILURE	FAILURE			5.200	5.200	0.262

TABLE 8-11. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 44

SPECIMEN NUMBER: 44
 SKIN/STRINGER: S-31 10 S/N 4 CYCLES TO FAILURE: 202870
 LOAD (KIPS): 153 % LIFE AT FAILURE: 108
 SPECTRUM: A-10 FINAL CRACK LGTH: 5.20
 HOLE DIA (INCHES): 0.262

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		STRINGER	TOTAL		CRACK		LENGTH
					R/FRONT	L/FRONT		R/FRONT	L/FRONT	SKIN	SKIN	
										FRONT	BACK	STRINGER
												FRONT
0	0	0	0	0				0.000		0.262	0.262	0.262
1	10	61	40	15905				0.024		0.262	0.262	0.286
1	11	61	44	83593				0.066		0.262	0.262	0.328
1	12	61	48	91287				0.097		0.262	0.262	0.359
1	13	61	52	97991				0.117		0.262	0.262	0.379
1	14	61	56	105679			0.111	0.131		0.262	0.373	0.393
1	15	61	60	113369			0.137	0.155		0.262	0.399	0.417
1	16	61	64	121061			0.169	0.176		0.262	0.431	0.430
1	17	61	68	128747			0.186	0.190		0.262	0.448	0.460
1	18	61	72	136440			0.213	0.242		0.262	0.475	0.504
1	19	61	76	143144			0.243	0.332	0.018	0.262	0.617	0.612
1	20	61	80	150833			0.276	0.301	0.177	0.262	0.678	0.820
1	21	61	84	158522			0.314	0.301	0.290	0.262	0.760	0.933
1	22	61	88	166211			0.348	0.301	0.356	0.262	0.839	0.999
1	23	23	90	169000			0.372	0.301	0.400	0.262	0.890	1.051
1	23	31	90	170057			0.380	0.301	0.433	0.262	0.902	1.076
1	23	46	91	171970			0.386	0.301	0.436	0.661	0.925	1.079
1	23	61	92	173090	0.399		0.397	0.381	0.444	0.670	0.948	1.087
1	24	16	93	175824	0.408		0.418	0.301	0.449	0.591	0.993	1.092
1	24	31	94	177743	0.429		0.427	0.301	0.461	0.701	1.013	1.104
1	24	46	95	179658	0.439		0.447	0.381	0.479	0.713	1.047	1.122
1	24	61	96	181592	0.451		0.463	0.301	0.479	0.728	1.084	1.122
1	25	16	97	183513	0.466		0.482	0.381	0.482	0.745	1.121	1.125
1	25	31	98	185432	0.483		0.494	0.301	0.492	0.761	1.152	1.125
1	25	46	99	187350	0.499		0.519	0.301	0.482	0.781	1.197	1.125
1	25	61	100	188284	0.519		0.534	0.301	0.402	0.796	1.232	1.128
2	1	21	101	190859	0.534		0.588	0.381	0.405	0.845	1.332	1.169
2	1	31	102	192125	0.503		0.609	0.381	0.526	0.864	1.369	1.169
2	1	46	103	194046	0.602		0.633	0.381	0.526	0.888	1.418	1.187
2	1	61	104	195971	0.626		0.677	0.381	0.544	0.925	1.512	1.189
2	2	16	105	197896	0.663		0.782	0.381	0.546	0.948	1.735	1.189
2	2	31	106	199813	0.786	N/A	0.902	0.301	0.546	1.168	1.981	1.189
2	2	45	107	201609	0.906	N/A	1.008	0.301	0.847	1.352	2.368	1.490
2	2	53	107	202700	1.090	N/A	1.098	0.301	0.847	1.982	4.108	FAILURE
2	2	55	108	202870	1.720	FAILURE	1.724	FAILURE	FAILURE	5.200	5.200	FAILURE

TABLE 8-12. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 45

SPECIMEN NUMBER: 45
 SKIN/STRINGER: S-33 3A S/N 1
 LOAD (KIP): 63.30
 SPECTRUM: CONST AMP
 HOLE SIZE (INCHES): 0.192
 CYCLES TO FAILURE: 79950
 % LIFE AT FAILURE:
 CRACK LGTH AT FAIL: 11.20

CYCLES	NEW CRACK LENGTH				TOTAL CRACK LENGTH			
	SKIN R/FRONT	SKIN L/FRONT	R/BACK	SKIN L/BACK	STRINGER R/FRONT	STRINGER L/FRONT	SKIN FRONT	SKIN BACK
0							0.192	0.192
31210				0.131			0.192	0.192
34290				0.174			0.192	0.192
37450				0.200			0.192	0.323
39950				0.306	0.040		0.192	0.366
44160				0.350	0.047		0.192	0.392
47370				0.400	0.054		0.192	0.442
49670				0.450	0.058		0.192	0.490
52690				0.499	0.074		0.192	0.542
54940				0.618	0.080		0.192	0.592
59970	0.619			0.704	0.154		0.192	0.642
63380	0.702			0.797	0.184		0.192	0.691
66000	0.792			0.901	0.215		0.811	0.810
68230	0.881			1.013	0.242		0.894	0.943
70710	1.013			1.137	0.242		0.984	1.097
72380	1.132	0.362	0.463	1.423	0.242		1.073	1.304
74970	1.469	0.671	0.719	1.724	0.242		1.567	1.532
76900	1.781	0.867	0.958	2.029	0.242		1.773	1.792
78080	2.078	1.159	1.206	2.279	0.242	0.140	2.332	2.334
78560	2.342	1.453	1.467	2.737	0.242	0.283	2.840	2.874
79140	2.813	1.973	1.993	3.037	FAILURE	FAILURE	3.429	3.427
79380	3.121	2.320	2.314	3.317	FAILURE	FAILURE	3.987	3.938
79540	3.411	2.633	2.594	3.752	FAILURE	FAILURE	4.978	4.922
79710	3.828	3.117	3.080	4.201	FAILURE	FAILURE	5.633	5.543
79820	4.261	3.617	3.585	4.702	FAILURE	FAILURE	6.236	6.103
79900	4.793	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	7.137	7.024
79950	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	8.070	7.978
							4.975	4.894
							0.192	0.192
							0.192	0.192

TABLE 8-13. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 46

SPECIMEN NUMBER: 46
 SKIN/STRINGER: S-33 3A S/N 2
 LOAD (KIP): 63.27
 SPECTRUM: CONST AMP
 HOLE SIZE (INCHES): 0.194
 CYCLES TO FAILURE: 72100
 % LIFE AT FAILURE:
 CRACK LGTH AT FAIL: 12.25

CYCLES	NEW CRACK LENGTH				TOTAL CRACK LENGTH			
	SKIN		STRINGER		SKIN		SKIN STRINGER	
	R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT	BACK	FRONT
22150				0.047			0.241	0.249
30770				0.137			0.331	0.283
33850				0.185		0.055	0.379	0.314
37160				0.217		0.089	0.431	0.332
40030				0.287		0.120	0.481	0.355
42130				0.306		0.130	0.500	0.369
44710				0.360		0.161	0.554	0.379
47420				0.409		0.175	0.603	0.409
50110				0.460		0.185	0.654	0.435
53050				0.513		0.215	0.707	0.448
57650			0.051	0.621		0.254	0.866	0.466
60610			0.160	0.719		0.272	1.073	0.401
63540	0.724	0.303	0.315	0.041		0.276	1.350	0.513
65440	0.994	0.417	0.434	0.942		0.306	1.570	0.524
67440	1.165	0.593	0.642	1.130		0.310	1.966	0.563
69440	1.395	0.841	0.878	1.396		0.337	2.460	0.602
70330	1.610	1.047	1.075	1.606		0.388	2.875	0.621
71710	2.972	2.522	2.434	2.993	FAILURE	FAILURE	5.608	7.751
71970	3.847	3.710	3.341	3.868			7.403	8.406
72020	4.284	3.928	3.809	4.203			9.340	12.250
72060	4.047	4.397	4.372	4.774				
72100	FAILURE	FAILURE	FAILURE	FAILURE				

LEFT STRINGER CRACK LENGTH OF .100 IS AN ESTIMATE

TABLE 8-14. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 47

SPECIMEN NUMBER: 47
 SKIN/STRINGER: S-33 3A S/N 3
 LOAD (KIPS): 133
 SPECTRUM: A-10
 HOLE DIA (INCHES): 0.194
 CYCLES TO FAILURE: 255661
 % LIFE AT FAILURE: 132
 FINAL CRACK LGTH: 5.40

LIFE	PASS	BLOCK	% OF LIFE	SKIN		SKIN		STRINGER		TOTAL SKIN FRONT	CRACK SKIN		LENGTH STRINGER FRONT
				CYCLES	R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT	BACK	FRONT	
1	1	0	0	0					0.000		0.194	0.194	0.194
1	8	61	32	66840					0.012		0.194	0.194	0.206
1	9	61	36	74500					0.033		0.194	0.194	0.227
1	10	61	40	82167					0.046		0.194	0.194	0.240
1	11	61	44	89825					0.064		0.194	0.194	0.258
1	12	61	48	97488					0.071		0.194	0.194	0.265
1	13	61	52	104166					0.082		0.194	0.194	0.276
1	14	61	56	111024					0.091		0.194	0.194	0.285
1	15	61	60	119404					0.099		0.194	0.194	0.293
1	16	61	64	127145					0.116		0.194	0.282	0.310
1	17	61	68	134803					0.110		0.304	0.312	0.312
1	18	61	72	142464				0.088	0.129		0.328	0.323	0.323
1	19	61	76	149142				0.134	0.139		0.348	0.333	0.333
1	20	61	80	156801				0.175	0.147		0.369	0.341	0.341
1	21	61	84	164461				0.189	0.157		0.383	0.351	0.351
1	22	61	88	172120				0.202	0.159		0.396	0.353	0.353
1	23	61	92	179776				0.231	0.176		0.509	0.370	0.370
1	24	61	96	187441			0.084		0.193		0.566	0.387	0.387
1	25	61	100	194119			0.118		0.198		0.609	0.392	0.392
2	1	61	104	201776			0.141		0.234		0.662	0.455	0.455
2	2	61	108	209434			0.163		0.235	0.027	0.703	0.465	0.465
2	3	61	112	217094			0.182		0.256	0.036	0.754	0.496	0.496
2	4	61	116	224753			0.202		0.284	0.046	0.827	0.551	0.551
2	5	61	120	232410			0.240		0.349	0.073	0.924	0.844	0.844
2	6	61	124	240072			0.286		0.422	0.301	1.099	0.967	0.967
2	7	61	128	246751			0.368		0.620	0.371	1.303	1.298	1.298
2	8	61	132	254413			0.466		FAILURE	0.476	2.644		
2				255661	1.420	1.257	1.143	1.307	FAILURE	FAILURE	2.871		

TABLE 8-15. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 48

SPECIMEN NUMBER: 48
 SKIN/STRINGER: S-33 3A S/N 4 CYCLES TO FAILURE: 224761
 LOAD (KIPS): 133 & LIFE AT FAILURE: 119
 SPECTRUM: A-10
 HOLE DIA (INCHES): 0.155 FINAL CRACK LGTH: 9.50

LIFE	PASS	BLOCK	% OF LIFE	SKIN		SKIN		STRINGER		TOTAL SKIN FRONT	CRACK SKIN		LENGTH STRINGER FRONT
				R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT		BACK	FRONT	
1	1	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.195	0.195	0.195	0.195
1	6	61	24					0.030		0.195	0.195	0.225	0.225
1	7	61	28					0.034		0.195	0.195	0.229	0.229
1	8	61	32					0.041		0.195	0.276	0.236	0.236
1	9	61	36					0.051		0.195	0.277	0.246	0.246
1	10	61	40					0.061		0.195	0.277	0.256	0.256
1	11	61	44					0.072		0.195	0.279	0.267	0.267
1	12	61	48					0.080		0.195	0.283	0.299	0.299
1	13	61	52					0.091	0.020	0.195	0.293	0.310	0.310
1	14	61	56					0.095	0.024	0.195	0.295	0.314	0.314
1	15	61	60					0.107	0.028	0.195	0.307	0.330	0.330
1	16	61	64					0.116	0.037	0.195	0.314	0.348	0.348
1	17	61	68					0.127	0.042	0.195	0.281	0.364	0.364
1	18	61	72					0.144	0.051	0.195	0.304	0.390	0.390
1	19	61	76					0.155	0.060	0.195	0.318	0.410	0.410
1	20	61	80					0.175	0.075	0.195	0.335	0.445	0.445
1	21	61	84					0.202	0.096	0.195	0.353	0.493	0.493
1	22	61	88					0.224	0.126	0.195	0.372	0.545	0.545
1	23	61	92					0.271	0.195	0.195	0.398	0.661	0.661
1	24	61	96					0.301	0.207	0.195	0.541	0.863	0.863
1	25	61	100					0.301	0.207	0.195	0.590	0.863	0.863
2	1	61	104					0.301	0.207	0.195	0.653	0.863	0.863
2	2	61	108					0.301	0.207	0.195	0.737	0.863	0.863
2	3	61	112					0.301	0.207	0.195	0.923	FAILURE	FAILURE
2	4	45	115					0.444	0.444	0.195	0.923	FAILURE	FAILURE
2	5	9	117					0.579	0.579	1.173	1.194	1.653	1.653
2	5	50	119					0.814	0.814	1.749	1.653	9.500	9.500
2	5							FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE

TABLE 8-16. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 49

SPECIMEN NUMBER:	49	CYCLES TO FAILURE:	66100
SKIN/STRINGER:	S-33 3B S/N 1	% LIFE AT FAILURE:	
LOAD (K LBS):	63.20		
SPECTRUM:	CONST AMP	CRCK LGTH AT FAIL:	11.30
HOLE SIZE(INCHES):	0.195		

CYCLES	SKIN			NEW CRACK LENGTH			TOTAL CRACK LENGTH				
	R/F	L/F	FRONT	R/BACK	SKIN	L/BACK	R/FRONT	STRINGER	SKIN	BACK	FRONT
0					0.000				0.195	0.195	0.195
26500					0.123				0.195	0.323	0.195
29000					0.185				0.195	0.300	0.195
32700					0.241				0.195	0.436	0.195
35700					0.295				0.195	0.490	0.195
38700			0.322		0.351				0.517	0.546	0.195
41000			0.380		0.416				0.583	0.611	0.195
43800			0.430		0.466				0.625	0.661	0.195
45800			0.481		0.514			0.057	0.676	0.709	0.252
47700			0.539		0.564			0.082	0.734	0.759	0.277
53300			0.697		0.721			0.119	0.892	1.022	0.314
61400	0.612		1.344		1.279	0.106		0.280	2.151	2.113	0.475
64300	1.219		1.892		1.971	1.252		0.280	3.306	3.418	0.475
65200	1.676		2.426		2.437	1.682		0.280	4.297	4.314	0.014
65800	2.431		3.285		3.310	2.432	0.339		5.906	5.937	
65900	2.780		3.880		3.754	2.881			6.860	6.830	
66000	3.380		4.295		4.304	3.371			7.870	7.870	
66100	3.870		4.895		4.894	3.881			8.960	8.970	
66100	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE			11.300	11.300	

TABLE 8-17. STRAIN SURVEY OF SPECIMEN NO. 50

SPECIMEN NUMBER SPECIMEN TYPE:		50 CENTER L	SPECTRUM: FINAL CRACK LGTH:		A-10 9	CYCLES TO FAILURE: APPLIED LOAD(LBS):		641585 50000				
CYCLES	% OF LIFE	CRACK LENGTH		***		STRAIN		(MICRO INCHES / INCH)		GAGE 9 L/BACK	GAGE 10	GAGE 11
		SKIN INCHES	STRINGER INCHES	GAGE 1 L/FRONT	GAGE 2 L/FRONT	GAGE 3 STRINGER	GAGE 4 R/FRONT	GAGE 5 R/FRONT	GAGE 6 R/STRING			
0	0	0.000	0.000	1236	1242	1145	1238	1235	1401	1410	1221	1216
38948	20	0.000	0.000	1236	1243	1135	1244	1245	1409	1423	1227	1219
106200	56	0.000	0.000	1223	1230	1124	1234	1233	1477	1428	1218	1208
151365	80	0.000	0.000	1230	1238	1135	1242	1240	1648	1461	1224	1214
188834	100	0.000	0.000	1229	1236	1134	1240	1239	1940	1480	1223	1212
196523	104	0.000	0.000	1228	1236	1134	1240	1238	2005	1503	1222	1211
204212	108	0.000	0.000	1229	1236	1134	1241	1239	2075	1510	1223	1212
211904	112	0.000	0.000	1227	1237	1135	1240	1237	2144	1516	1222	1211
219594	116	0.000	0.000	1227	1236	1134	1239	1237	OFFSCALE	1524	1222	1211
234975	124	0.263	0.297	1235	1244	1145	1246	1245		1545	1228	1219
272440	144	0.296	0.307	1227	1237	1137	1240	1237		1616	1224	1214
294529	156	0.334	0.320	1226	1236	1140	1242	1239		1629	1227	1213
325174	172	0.359	0.351	1228	1240	1142	1243	1238		1666	1232	1217
354828	188	0.418	0.377	1232	1246	1151	1247	1242		1711	1241	1223
376828	200	0.451	0.406	1229	1247	1153	1249	1240		1807	1244	1223
384485	204	0.465	0.425	1227	1250	1156	1253	1239		1933	1249	1222
312944	208	0.632	0.475	1233	1266	1177	1269	1244		2417	1258	1226
399804	212	0.630	0.511	1237	1257	1185	1278	1247		3112	1266	1233
407463	216	0.657	0.511	1243	1283	1188	1285	1254	OFFSCALE	3523	1493	1241
415121	220	0.694	0.595	1239	1283	1180	1285	1251		1699	1699	1241
422783	224	0.726	0.633	1230	1278	1168	1283	1243		1935	1935	1236
444783	236	0.832	0.728	1252	1309	1179	1312	1265		1605	1605	1267
467760	248	0.944	0.825	1250	1315	1161	1321	1262		1460	1460	1280
489758	260	1.063	0.925	1230	1290	1131	1308	1246		919	919	1246
527077	280	1.281	1.109	1229	1318	1090	1342	1247		620	620	1299
534737	284	1.323	1.141	1232	1326	1082	1354	1249		683	683	1314
564394	300	1.514	1.468	1255	1393	1060	1430	1274		599	599	1423
587369	312	1.702	1.694	1258	1468	975	1538	1276		802	802	1546
610348	324	2.028	2.016	1280	1775	547	2361	1303		1907	1907	2243
617027	328	2.028	2.016	1293	2470	452	4098	1319		3807	3807	3215
624688	332	2.599	2.591	1321	4951	444	OFFSCALE	1351		OFFSCALE	OFFSCALE	1127
632349	336	3.141	3.154	1383	OFFSCALE	801		1423				840
640007	340	6.099	FAILURE	2733		1294		3717				OFFSCALE



TABLE 8-18. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 50

SPECIMEN NUMBER: 50
 SKIN/STRINGER: S-33 JO S/N 2
 LOAD (KIIPS): 104
 SPECTRUM: A-10
 HOGE DIA(INCHES): 0.195
 CYCLES TO FAILURE: 641505
 & LIFE AT FAILURE: 344
 FINAL CRACK LGTH: 9.00

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		STRINGER		TOTAL		CRACK		LIFE/CRACK
					R/FRONT	L/BACK	R/FRONT	L/FRONT	R/FRONT	L/BACK	R/BACK	L/FRONT	
1	1	0	0	0	0.000				0.000		0.195	0.195	0.195
2	6	61	124	234975	0.068				0.102		0.263	0.297	0.297
2	7	61	120	241600	0.072				0.107		0.267	0.302	0.302
2	8	61	132	249673	0.074				0.043		0.269	0.238	0.238
2	9	61	136	257063	0.077				0.008		0.272	0.283	0.283
2	10	61	140	264752	0.080				0.107		0.275	0.302	0.302
2	11	61	144	272440	0.101				0.112		0.296	0.307	0.307
2	12	61	148	280135	0.119				0.116		0.314	0.311	0.311
2	13	61	152	286840	0.132				0.125		0.327	0.314	0.314
2	14	61	156	294529	0.139				0.125		0.334	0.320	0.320
2	15	61	160	302193	0.145				0.133		0.340	0.328	0.328
2	16	61	164	309854	0.157				0.142		0.352	0.337	0.337
2	17	61	168	317512	0.164				0.152		0.358	0.347	0.347
2	18	61	172	325174	0.164				0.156		0.359	0.351	0.351
2	19	61	176	332852	0.192				0.162		0.387	0.357	0.357
2	20	61	180	339511	0.205				0.171		0.400	0.366	0.366
2	21	61	184	347170	0.217				0.179		0.412	0.374	0.374
2	22	61	186	354020	0.223				0.182		0.418	0.377	0.377
2	23	61	192	362484	0.232				0.189		0.427	0.384	0.384
2	24	61	196	370150	0.249				0.200		0.444	0.395	0.395
2	25	61	200	376020	0.256				0.211		0.451	0.404	0.404
3	1	61	204	384485	0.270				0.230		0.465	0.425	0.425
3	2	61	208	392944	0.290				0.280		0.632	0.475	0.475
3	3	61	212	397007	0.304				0.316		0.630	0.511	0.511
3	4	61	216	407463	0.316				0.316		0.657	0.511	0.511
3	5	61	220	415121	0.335				0.338	0.062	0.694	0.595	0.595
3	6	61	224	422703	0.352				0.359	0.079	0.726	0.633	0.633
3	7	61	228	429461	0.366				0.369	0.098	0.753	0.662	0.662
3	8	61	232	437123	0.386				0.387	0.114	0.794	0.696	0.696
3	9	61	236	444703	0.403				0.401	0.132	0.832	0.728	0.728
3	10	61	240	452441	0.429				0.421	0.147	0.872	0.763	0.763
3	11	61	244	460097	0.443				0.441	0.165	0.907	0.801	0.801
3	12	61	248	467760	0.459				0.451	0.179	0.944	0.835	0.835
3	13	61	252	474430	0.471				0.470	0.194	0.972	0.859	0.859
3	14	61	256	480747	0.492				0.485	0.209	1.017	0.889	0.889
3	15	61	260	489759	0.515				0.504	0.226	1.063	0.923	0.923
3	16	61	264	497420	0.538				0.531	0.244	1.105	0.970	0.970
3	17	61	268	505070	0.559				0.544	0.260	1.141	0.999	0.999
3	18	61	272	512739	0.583				0.571	0.273	1.184	1.039	1.039
3	19	61	276	519417	0.596				0.579	0.283	1.227	1.057	1.057
3	20	61	280	527077	0.632				0.616	0.298	1.281	1.109	1.109
3	21	61	284	534737	0.642				0.637	0.309	1.323	1.141	1.141
3	22	61	288	542396	0.670				0.655	0.319	1.382	1.169	1.169
3	23	61	292	550051	0.681				0.669	0.331	1.415	1.195	1.195
3	24	61	296	557716	0.715				0.681	0.336	1.475	1.212	1.212
3	25	61	300	564394	0.730				0.700	0.373	1.514	1.268	1.268
4	1	61	304	572051	0.794				0.750	0.378	1.505	1.521	1.521
4	2	61	308	579079	0.827				0.773	0.647	1.671	1.615	1.615
4	3	61	312	587369	0.837				0.819	0.680	1.702	1.594	1.594
4	4	61	316	595029	0.881				0.863	0.728	1.779	1.586	1.586
4	5	61	320	602686	0.901				0.917	0.767	1.878	1.879	1.879
4	6	61	324	610348	1.017				0.986	0.835	2.028	2.016	2.016
4	7	61	328	617027	1.138				1.114	0.947	2.244	2.256	2.256
4	8	61	332	624608	1.233				1.315	1.081	2.599	2.591	2.591
4	9	61	336	632349	1.664				1.321	FAILURE	3.141	3.154	3.154
4	10	61	340	640007	2.572	3.033	FAILURE		FAILURE	FAILURE	6.099	FAILURE	FAILURE
4	11	61	344	641461	4.344	3.996	FAILURE		FAILURE	FAILURE	8.534	FAILURE	FAILURE
4	11	61	344	641505	4.344	3.996	FAILURE		FAILURE	FAILURE	8.534	FAILURE	FAILURE

TABLE 8-19. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 51

SPECIMEN NUMBER: 51
 SKIN/STRINGER: S-33 3B S/N 3
 LOAD (KIPS): 63.30
 SPECTRUM: CONST AMP
 HOLE SIZE(INCHES): 0.192
 CYCLES TO FAILURE: 79700
 % LIFE AT FAILURE:
 CRACK LGTH AT FAIL: 11.80

CYCLES	NEW CRACK LENGTH				TOTAL CRACK LENGTH			
	SKIN		STRINGER		SKIN		SKIN STRINGER	
	R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT	FRONT	BACK FRONT
0								
36700			0.000		0.192		0.192	0.192
40060			0.192		0.247		0.192	0.384
44200			0.302		0.302		0.192	0.439
46000			0.333		0.333		0.192	0.494
47800			0.368		0.368		0.192	0.525
48500			0.376		0.426	0.081	0.192	0.550
51100		0.375	0.416		0.514	0.087	0.567	0.558
55900		0.500	0.673		0.705	0.109	0.608	0.618
62300		0.657	0.790		1.000	0.136	0.700	0.706
66800		0.990	1.411		1.523	0.176	0.849	0.865
70900		1.916	2.419		2.935	0.239	0.982	0.897
75200		2.419	3.408		4.955	FAILURE	1.182	1.398
77600	0.874	1.362	2.346		5.000	FAILURE	1.603	2.414
78600	1.857	2.897	4.943		FAILURE	FAILURE	2.982	2.984
79200	2.897	5.000	FAILURE		FAILURE	FAILURE	3.973	4.008
79400	FAILURE	FAILURE	FAILURE		FAILURE	FAILURE	4.968	4.986
79600	FAILURE	FAILURE	FAILURE		FAILURE	FAILURE	5.946	6.418
79700	FAILURE	FAILURE	FAILURE		FAILURE	FAILURE	7.025	7.044
79700	FAILURE	FAILURE	FAILURE		FAILURE	FAILURE	10.135	10.147
79700	FAILURE	FAILURE	FAILURE		FAILURE	FAILURE	11.800	11.800

TABLE 8-20. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 52

SPECIMEN NUMBER: 52
 SKIN/STRINGER: S-33 3B S/N 4
 LOAD (KIPS): 104
 SP. CT. RUM: A-10
 HOLE DIA (INCHES): 0.195
 CYCLES TO FAILURE: 685542
 % LIFE AT FAILURE: 368
 FINAL CRACK LGTH: 9.70

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN R/FRONT	SKIN L/FRONT	R/BACK	L/BACK	STRINGER R/FRONT	STRINGER L/FRONT	TOTAL SKIN FRONT	CRACK SKIN BACK	LENGTH STRINGER FRONT
1	3	61	12	22973							0.195	0.195	0.195
1	15	61	60	112920							0.195	0.195	0.195
1	19	61	76	142585							0.195	0.195	0.195
2	11	61	144	270832			0.111			0.036	0.195	0.306	0.231
2	13	61	152	285174			0.133			0.054	0.195	0.328	0.249
2	15	61	160	300942			0.146			0.073	0.195	0.341	0.268
2	17	61	168	315811			0.166			0.070	0.195	0.361	0.265
2	19	61	176	330151			0.184			0.112	0.195	0.379	0.307
2	21	61	184	345467			0.207			0.112	0.195	0.402	0.307
2	23	61	192	360783			0.224			0.117	0.195	0.419	0.312
2	25	61	200	375121			0.245			0.128	0.195	0.440	0.323
3	1	61	204	382792			0.252			0.132	0.195	0.447	0.327
3	3	61	212	390101			0.270			0.145	0.195	0.465	0.340
3	5	61	220	413414			0.294			0.159	0.195	0.489	0.354
3	7	61	228	427755			0.315			0.170	0.195	0.510	0.365
3	9	61	236	443076			0.336			0.187	0.195	0.531	0.382
3	11	61	244	458391			0.360	0.094	0.010	0.212	0.195	0.649	0.417
3	13	61	252	472732			0.384	0.123	0.073	0.387	0.195	0.706	0.605
3	15	61	260	486050			0.425	0.166	0.031	0.424	0.195	0.786	0.650
3	17	61	268	503069			0.462	0.196	0.065	0.460	0.195	0.853	0.720
3	19	61	276	517709			0.494	0.232	0.103	0.490	0.195	0.921	0.788
3	21	61	284	533027			0.527	0.266	0.135	0.521	0.195	0.988	0.851
3	23	61	292	540342			0.573	0.316	0.171	0.563	0.195	1.084	0.929
3	25	61	300	562687			0.607	0.363	0.203	0.617	0.195	1.165	1.015
4	1	61	304	570345			0.644	0.389	0.223	0.637	0.195	1.228	1.055
4	3	61	312	585665			0.669	0.446	0.259	0.684	0.195	1.310	1.138
4	5	61	320	600981			0.756	0.500	0.305	0.731	0.195	1.451	1.231
4	7	61	328	615332			0.837	0.565	0.557	0.784	0.195	1.597	1.536
4	9	61	336	630642			0.880	0.644	0.640	0.869	0.195	1.719	1.704
4	11	61	344	645958			0.957	0.743	0.730	0.947	0.195	1.895	1.872
4	12	61	348	653621			1.020	0.800	0.704	0.996	0.195	2.023	1.975
4	13	61	352	660300			1.075	0.930	0.860	1.065	0.195	2.208	2.128
4	14	61	356	667959			1.173	0.993	0.970	1.153	0.195	2.361	2.318
4	15	61	360	675619			1.391	1.238	1.225	1.361	0.195	2.824	2.781
4	16	61	364	683281			1.892	1.791	1.777	1.886	0.195	3.878	3.858
4	17	61	368	685542			2.474	2.159	2.308	2.486	0.195	5.028	5.069
4				683155			FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	5.700	9.700

TABLE 8-21. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 53

SPECIMEN NUMBER: 53
 SKIN/STRINGER: S-35-SA S/N 1
 LOAD(KIPS): 104.50
 SPECTRUM: CONST AMP
 HOLE SIZE(INCHES): 0.261
 CYCLES TO FAILURE: 64725
 % LIFE AT FAILURE:

CYCLES	NEW CRACK LENGTH				TOTAL CRACK LENGTH			
	SKIN		STRINGER		SKIN		STRINGER	
	R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT	R/BACK	L/BACK
0								
42568					0.000	0.000		
43456					0.265			
43694					0.330			
43900					0.370			
44141					0.424			
47075					0.470			
47452					0.470	0.165		
48023					0.470	0.219		
48353					0.470	0.273		
48703					0.470	0.335		
49000					0.470	0.385		
49301					0.470	0.446		
49500					0.470	0.537		
49700					0.470	0.628		
60587								
64720	4.270	2.800	2.898	0.123				
64725	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE

CRACK ALSO OCCURRED AT RADIUS IN GRIP REGION

TABLE 8-22. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 54

SPECIMEN NUMBER: 54
 SKIN/STRINGER: S-35-5A S/N 2
 LOAD (KIP): 104.50
 SPECTRUM: CONST AMP
 HOLE SIZE(INCHES): 0.252
 CYCLES TO FAILURE: 69747
 % LIFE AT FAILURE:

CYCLES	NEW CRACK LENGTH				TOTAL CRACK LENGTH			
	SKIN		STRINGER		SKIN		STRINGER	
	R/FRONT	L/FRONT	R/DACK	L/DACK	R/FRONT	L/FRONT	R/FRONT	L/FRONT
0								
38090			0.000		0.252	0.252	0.252	0.252
43000			0.142		0.252	0.252	0.252	0.252
48030			0.226		0.252	0.394	0.252	0.252
52300			0.307		0.252	0.478	0.252	0.252
56890			0.417		0.252	0.559	0.252	0.252
61000			0.539		0.252	0.669	0.442	0.442
65570			0.702		0.797	0.791	0.727	0.727
66560			1.081	0.303	0.975	0.954	0.727	0.727
66850			1.238	0.516	1.333	1.642	0.727	0.727
68000			1.314	0.689	1.490	2.005	0.827	0.827
68760			1.820	0.689	1.566	2.257	0.940	0.940
69020			2.318	1.047	2.072	2.760	1.388	1.388
69230			2.556	1.204	2.570	3.620	1.788	1.788
69350			2.810	1.475	2.800	4.016	1.788	1.788
69460			3.030	1.975	3.062	4.544	1.804	1.804
69530	1.903		3.554	2.075	5.185	5.272	2.059	2.059
69540	2.075		4.036	2.075	5.881	5.915		
69542	2.075		4.937	2.075	6.363	6.374		
69545	2.075		5.955	2.075	7.264	7.250		
69547	2.075	FAILURE	7.425	2.075	8.282	8.250		
	FAILURE	FAILURE	FAILURE	FAILURE	9.752	9.700		
					12.900	12.900		

TABLE 8-23. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 55

SPECIMEN NUMBER: 55
 SKIN/STRINGER: S-35-SA S/N 3
 LOAD (KIPS): 219.7
 SPECTRUM: A-10
 HOLE DIA(INCHES): 0.253
 CYCLES TO FAILURE: 100823
 % LIFE AT FAILURE: 53
 FINAL CRACK LGTH: 3.10

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		SKIN R/BACK	L/BACK	STRINGER		TOTAL SKIN FRONT	CRACK SKIN BACK		LENGTH STRINGER FRONT
					R/FRONT	L/FRONT			R/FRONT	L/FRONT				
1	1	0	0	0			0.000				0.253	0.253	0.253	
1	8	61	32	60801			0.084				0.253	0.337	0.253	
1	9	44	35	66458			0.105				0.253	0.358	0.253	
1	9	61	36	68526			0.118				0.253	0.371	0.253	
1	10	44	39	74180			0.136				0.253	0.389	0.253	
1	10	61	40	76246			0.143				0.253	0.396	0.253	
1	11	61	44	83965			0.176				0.253	0.429	0.253	
1	12	44	47	89618			0.217		0.106		0.253	0.470	0.359	
1	12	61	48	91689			0.223		0.140		0.253	0.476	0.393	
1	13	44	51	97343			0.272	0.110	0.240		0.253	0.635	0.501	
1	13	53	51	98421			0.298	0.151	0.440		0.253	0.702	0.693	
1	14	19	53	100823			FAILURE	FAILURE	FAILURE	FAILURE	3.109	3.100	FAILURE	

TABLE 8-24. STRAIN SURVEY OF SPECIMEN NO. 56

SPECIMEN NUMBER: 56		SPECTRUM: A-10		CYCLES TO FAILURE: 160900									
SPECIMEN TYPE: EDGE L		FINAL CRACK LGTH: 5		APPLIED LOAD(LBS): 132000									
CYCLES	% OF LIFE	CRACK LENGTH		STRAIN (M I C R O I N C H E S / I N C H)									
		SKIN INCHES	STRINGER INCHES	GAGE 1 L/STRING	GAGE 2 L/STRING	GAGE 3 SKIN/F	GAGE 4 R/STRING	GAGE 5 R/STRING	GAGE 6 B/C/SKIN	GAGE 7 B/C/SKIN	GAGE 8 B/SKIN	GAGE 9 B/SKIN	
0	0	0.000	0.000	1614	1959	2108	1927	1599	2093	2069	2192		
23170	12	0.000	0.000	1525	1934	2181	1815	1554	2174	2133	2276		
46336	24	0.000	0.000	1519	1932	2176	1806	1546	2165	2134	2275		
68523	36	0.000	0.000	1530	1949	2192	1827	1567	2183	2168	2303		
91685	48	0.000	0.000	1533	1951	2199	1867	1571	2184	2176	2311		
106137	56	0.000	0.000	1533	1951	2213	1944	1575	2184	2181	2317		
121581	64	0.000	0.418	1542	1962	2260	2340	1599	2195	2167	2328		
123637	65	0.000	0.447	1538	1961	2275	2631	1604	2202	2165	2337		
125692	66	0.000	0.460	1539	1960	2256	2644	1602	2189	2158	2331		
127748	67	0.000	0.481	1541	1963	2292	2972	1617	2198	2172	2348		
129299	68	0.000	0.556	1543	1964	2289	2089	1617	2186	2164	2346		
131754	69	0.000	0.720	1540	1963	2350	6026	1671	2178	2184	2384		
133410	70	0.000	0.878	1542	1963	2403	10316	1725	2181	2240	2404		
135465	71	0.000	0.999	1541	1963	2500	OFFSCALE	1816	2233	2390	2449		
137022	72	0.000	1.158	1542	1965	2589	OFFSCALE	1908	2309	2523	2495		
139077	73	0.000	1.399	1528	1959	2797		2207	2603	2763	2586		
147866	78	0.330	1.399	1541	1965	2830		2232	2601	2998	2560		
151530	81	0.349	1.863	1534	1959	2865		2266	2649	3545	2561		
155586	82	0.473	1.903	1537	1959	2881		2269	2662	3719	2572		
157642	83	0.598	2.014	1531	1952	3002		2388	2773	2537	2695		
159196	84	0.657	2.071	1535	1955	3135		2468	2872	788	2816		
160900	85	5.000	FAILURE										

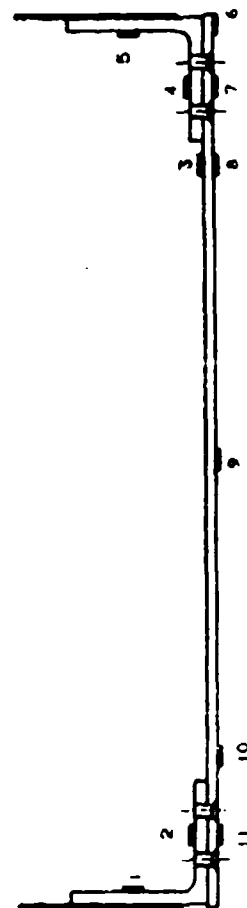


TABLE 8-25. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 56

SPECIMEN NUMBER: 56
 SKIN/STRINGER: S-35-SA-S/N 4
 LOAD (KIPS): 219.7
 SPECTRUM: A-10
 HOLE DIA (INCHES): 0.253
 CYCLES TO FAILURE: 160900
 % LIFE AT FAILURE: 85
 FINAL CRACK LGTH: 5.00

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN R/FRONT	SKIN L/FRONT	R/BACK	L/BACK	STRINGER R/FRONT	STRINGER L/FRONT	TOTAL SKIN FRONT	CRACK SKIN BACK	LENGTH STRINGER FRONT
1	1	0	0	0			0.000			0.000	0.253	0.253	0.253
1	16	61	64	121581						0.165	0.253	0.253	0.418
1	17	16	65	123637			0.000			0.194	0.253	0.253	0.447
1	17	32	66	125692			0.000			0.207	0.253	0.253	0.460
1	17	48	67	127748						0.220	0.253	0.253	0.481
1	17	61	68	129299					0.062	0.241	0.253	0.253	0.556
1	18	16	69	131354					0.096	0.371	0.253	0.253	0.720
1	18	32	70	133410					0.169	0.456	0.253	0.253	0.878
1	18	48	71	135465					0.290	0.456	0.253	0.253	0.999
1	18	61	72	137022					0.449	0.456	0.253	0.253	1.158
1	19	16	73	139077					0.690	0.456	0.253	0.253	1.399
1	20	32	78	147866			0.077		0.690	0.456	0.253	0.330	1.399
1	21	16	81	153530			0.096		1.154	0.456	0.253	0.349	1.863
1	21	32	82	155586			0.106	0.114	1.194	0.456	0.253	0.473	1.903
1	21	48	83	157642			0.126	0.219	1.305	0.456	0.253	0.598	2.014
1	21	61	84	159196			0.156	0.240	1.362	0.456	0.253	0.657	2.071
1	22	13	85	160900	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	5.000	5.000	FAILURE

NO CRACK WAS OBSERVED ON THE FRONT SKIN BEFORE FAILURE

TABLE 8-26. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 57

SPECIMEN NUMBER: 57
 SKIN/STRINGER: S-35-5B S/N 1
 LOAD (KIP): 104.50
 SPECTRUM: CONST AMF
 HOLE SIZE (INCHES): 0.252

CYCLES TO FAILURE: 92784
 & LIFE AT FAILURE:

CYCLES	SKIN		NEW CRACK LENGTH		STRINGER		TOTAL CRACK LENGTH	
	R/FRONT	L/FRONT	R/BACK	SKIN L/BACK	R/FRONT	L/FRONT	SKIN FRONT	SKIN BACK
0	0.000			0.000			0.252	0.252
31669				0.155			0.252	0.407
36669				0.272			0.252	0.524
41669				0.363			0.252	0.615
46668				0.474			0.252	0.726
51668				0.623			0.252	0.875
56684				0.780			0.252	1.032
59736				0.981			0.252	1.233
60040	1.071			1.120			1.323	1.372
65040	1.071		0.088	1.120			1.323	1.460
70949	1.071		0.676	1.120			1.323	2.048
81676	1.071		1.110	1.120			1.323	2.482
87389	1.071	1.522	1.540	1.120			2.845	2.912
88859	1.071	2.026	2.049	1.120			3.349	3.421
89834	1.071	2.525	2.555	1.120			3.840	3.927
90408	1.071	2.936	2.995	1.120			4.259	4.367
90970	1.071	3.462	3.522	1.120			4.785	4.894
91358	1.071	3.963	4.011	1.120			5.286	5.303
91636	1.071	4.408	4.450	1.120			5.731	5.822
91089	1.071	4.918	4.996	1.120			6.241	6.368
92073	1.071	5.366	5.412	1.120			6.689	6.784
92252	1.071	5.893	5.945	1.120			7.216	7.317
92382	1.071	6.338	6.361	1.120			7.661	7.777
92506	1.071	6.879	6.900	1.120			8.202	8.272
92604	1.071	7.394	7.413	1.120			8.717	8.785
92681	1.071	7.856	7.880	1.120			9.179	9.252
92750	1.071	8.386	8.400	1.120			9.709	9.772
92783	1.071	10.364	10.347	1.120			11.687	11.719
92784	FAILURE	FAILURE	FAILURE	FAILURE			11.700	FAILURE

NO CRACK APPEARED ON STRINGER PRIOR TO FAILURE

TABLE 8-28. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 59

SPECIMEN NUMBER: 59
 SKIN/STRINGER: 9-33 30 9/N 3
 LOAD (KIPS): 219.8
 SPECTRUM: A-10
 HOLE DIA (INCHES): 0.248
 CYCLES TO FAILURE: 173713
 % LIFE AT FAILURE: 92
 FINAL CRACK LGTH: 3.50

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		SKIN		STRINGER		TOTAL SKIN FRONT	CRACK SKIN BACK		LENGTH STRINGER FRONT
					R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT		BACK	FRONT	
1	1	0	0	0				0.000			0.248	0.248	0.248	0.248
1	13	61	52	98414				0.096			0.248	0.344	0.248	0.248
1	14	61	56	106113				0.115			0.248	0.363	0.248	0.248
1	15	61	60	113856				0.171			0.248	0.419	0.248	0.248
1	16	61	64	121579				0.212			0.248	0.460	0.248	0.248
1	17	61	68	129290				0.258			0.248	0.506	0.248	0.248
1	18	61	72	137021				0.291			0.248	0.539	0.248	0.248
1	19	61	76	143754				0.340	0.127		0.248	0.588	0.375	0.375
1	20	61	80	151474				0.377	0.166		0.248	0.625	0.414	0.414
1	21	61	84	159195				0.431	0.203		0.248	0.679	0.451	0.451
1	22	61	88	166915				0.520	0.259	0.854	0.248	0.768	1.361	1.361
1	23	55	92	173913	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	3.500	3.500	FAILURE	FAILURE

NO CRACK AS DETECTED ON THE FRONT SKIN

TABLE 8-29. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 60

SPECIMEN NUMBER: 60
 SKIN/STRINGER: S-35-50 S/N 4
 LOAD (KIPS): 219.8
 SPECTRUM: A-10
 HOLE DIA(INCHES): 0.251
 CYCLES TO FAILURE: 130030
 % LIFE AT FAILURE: 68
 FINAL CRACK LGTH: 3.10

I.IFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		SKIN		STRINGER		TOTAL		CRACK		LENGTH STRINGER FRONT
					R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT	SKIN FRONT	SKIN BACK	SKIN BACK	SKIN BACK	
1	1	0	0	0				0.000			0.251	0.251	0.251	0.251	0.251
1	10	61	40	76237				0.090			0.251	0.251	0.341	0.251	0.251
1	11	44	43	81090				0.132			0.251	0.251	0.383	0.251	0.251
1	11	61	44	83305				0.147			0.251	0.251	0.398	0.251	0.251
1	12	44	47	89609				0.187			0.251	0.251	0.438	0.251	0.251
1	12	61	48	91600				0.190			0.251	0.251	0.441	0.251	0.251
1	13	31	50	95663				0.217			0.251	0.251	0.468	0.251	0.251
1	13	53	51	90411				0.234			0.251	0.251	0.485	0.251	0.251
1	14	51	55	102394				0.252			0.251	0.251	0.503	0.251	0.251
1	14	61	56	106131				0.278			0.251	0.251	0.529	0.342	0.342
1	15	31	50	110114			0.123	0.310			0.251	0.251	0.604	0.358	0.358
1	15	61	60	113852			0.153	0.340			0.251	0.251	0.752	0.384	0.384
1	16	31	62	117034			0.210	0.396			0.251	0.251	0.857	0.406	0.406
1	16	61	64	121574			0.261	0.446			0.251	0.251	0.958	0.440	0.440
1	17	31	66	125557			0.372	0.567			0.251	0.251	1.190	0.477	0.477
1	17	46	67	127479			0.706	1.075			0.251	0.251	2.032	0.529	0.529
1	17	57	68	128037			1.295	1.075		0.101	0.251	0.251	2.621	0.687	0.687
1	17	61	68	129293			1.394	1.075		0.140	0.251	0.251	2.720	0.752	0.752
1	18	3	68	129589			1.549	1.075		0.208	0.251	0.251	2.875	0.870	0.870
1	18	5	68	129891		1.721	1.730	1.075		0.294	1.972	1.972	3.056	1.012	1.012
1	18	6	68	130030	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	3.100	3.100	3.100	FAILURE	FAILURE

TABLE 8-30. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 61

SPECIMEN NUMBER: 61
 SPECIMEN TYPE: CENTER T
 SKIN/STRINGER: S-37-7A S/N 1
 LOAD (KIPS): 219.9
 STRESS (KSI): 30.5
 SPECTRUM : AMAVS
 CYCLES TO FAILURE: 146742
 % LIFE AT FAILURE: 100
 LOAD AT FAILURE: 159390
 FINAL CRACK LGTH: 4.6
 HOLE DIA (INCHES): 0.311

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		SKIN		STRINGER		TOTAL CRACK LENGTH	
					R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT	SKIN FRONT	SKIN BACK
1	1	0	0	0					0.000		0.311	0.311
1	7	88	54	79019					0.221		0.311	0.532
1	8	88	62	90306			0.132		0.348		0.311	0.659
1	9	88	69	101595			0.259		0.440		0.311	0.751
1	10	88	77	112882			0.372		0.489		0.311	0.800
1	11	88	85	124168			0.498		0.526		0.311	0.837
1	12	88	92	135455			0.678		0.526		0.311	0.989
1	13	88	100	146742	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	4.600	FAILURE

FAILURE OCCURRED AT 159390 POUNDS

TABLE 8-31. STRAIN SURVEY OF SPECIMEN NO. 62

SPECIMEN NUMBER: 62
 SPECIMEN TYPE: CENTER T
 SPECTRUM: AMAS
 FINAL CRACK LGTH: 2.8
 CYCLES TO FAILURE: 540007
 APPLIED LOAD(LBS): 132000

CYCLES	% OF LIFE	CRACK LENGTH		GAGE 1 L/F/SKIN	GAGE 2 L/F/SKIN	GAGE 3 F/STRING	STRAIN			THICK 0 INCHES / INCH									
		SKIN INCHES	STRINGER INCHES				GAGE 4 R/F/SKIN	GAGE 5 R/F/SKIN	GAGE 6 L/B/SKIN	GAGE 7 C/B/SKIN	GAGE 8 R/B/SKIN	GAGE 9	GAGE 10	GAGE 11					
0	0	0.000	0.000	1746	1727	1227	1779	1753	1689	1715	1749								
67736	46	0.000	0.000	1741	1737	1187	1788	1776	2205	1720	1744								
101609	69	0.000	0.000	1754	1747	1203	1800	1788	2245	1731	1752								
158042	108	0.000	0.000	1736	1737	1202	1789	1775	1960	1723	1741								
203197	138	0.000	0.000	1717	1717	1316	1708	1737	1757	1711	1731								
259639	177	0.000	0.000	1732	1729	2486	2031	1754	1785	1724	1742								
293500	200	0.000	0.000	1731	1729	3712	2850	1753	1783	1724	1742								
304790	207	0.000	0.000	1722	1720	6574	4233	1743	1776	1715	1733								
327368	223	0.000	0.000	1719	1719	5174	3173	1741	1774	1715	1732								
338655	230	0.000	0.000	1719	1717	14300	2680	1741	1773	1713	1733								
349942	238	0.000	0.454	1721	1719	10455	6760	1746	1773	1714	1733								
355597	242	0.000	0.457	1736	1724	OFFSCALE	12466	1745	1772	1714	1738								
383809	261	0.000	0.473	1720	1720	4607	4899	1747	1774	1712	1733								
406382	276	0.000	0.496	1726	1727	1695	1730	1758	1780	1715	1740								
412036	280	0.424	0.498	1718	1724	1334	1716	1729	1745	1710	1729								
440370	300	0.426	0.508	1714	1727	1336	1728	1748	1755	1709	1733								
474228	323	0.426	0.523	1707	1722	1329	1750	OFFSCALE	1751	1692	1724								
485516	330	0.426	0.529	1708	1725	1337	2581	OFFSCALE	1753	1688	1729								
508095	346	0.426	0.535	1710	1729	1339	5470		1759	1681	1729								
519385	353	0.426	0.538	1709	1735	1344	1737	1725	1766	1677	1730								
530673	361	0.426	0.549	1711	1742	1338	1746	1724	1772	1658	1732								
541962	369	0.426	0.553	1726	1699	1318	1812	1737	1839	1534	1641								
544007	370	FAILURE	FAILURE																

AS CAN BE SEEN IN THE ABOVE TABLE SEVERAL PROBLEMS WERE ENCOUNTERED IN RECORDING STRAIN DATA WHERE THE STRAIN BECAME ABNORMALLY HIGH. IN MOST CASES THIS WAS DUE TO A DISCONNECT OF THE LEADWIRE

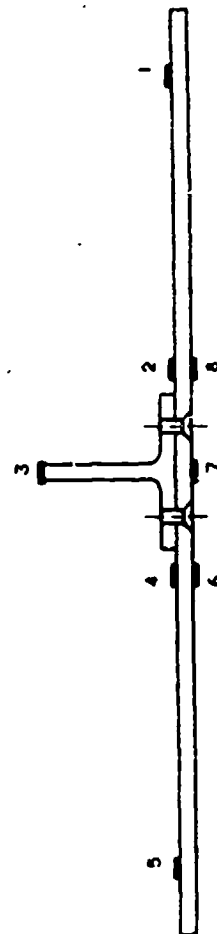


TABLE 8-32. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 62

SPECIMEN NUMBER: 62
 SPECIMEN TYPE: CENTER T
 SKIN/STRINGER: S-37-7A S/N 2
 LOAD (KIPS): 219
 STRESS (KSI): 30.5
 SPECTRUM: AMAVS

CYCLES TO FAILURE: 544007
 % LIFE AT FAILURE: 371
 FAILURE LOAD(LBS): N/A
 FINAL CRACK LGTH: 2.8
 HOLE DIA (INCHES): 0.312

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		SKIN		STRINGER	TOTAL CRACK LENGTH	
					R/FRONT	L/FRONT	R/BACK	L/BACK		SKIN FRONT	SKIN BACK
1	1	0	0	0			0.000		0.000	0.312	0.312
3	5	88	238	349942					0.142	0.312	0.454
3	6	44	242	355597					0.145	0.312	0.457
3	6	88	246	361231					0.151	0.312	0.463
3	7	44	250	366887					0.156	0.312	0.468
3	7	88	254	372520					0.161	0.312	0.473
3	8	44	258	378176					0.161	0.312	0.473
3	8	88	262	383809					0.161	0.312	0.473
3	9	44	265	38463					0.161	0.312	0.473
3	9	88	269	395097					0.161	0.312	0.473
3	10	44	273	400750					0.170	0.312	0.482
3	10	88	277	406383					0.184	0.312	0.496
3	11	44	281	412036					0.186	0.312	0.498
3	11	88	288	423323			0.112		0.191	0.312	0.503
3	12	44	292	429084			0.115		0.191	0.312	0.503
3	12	88	296	434737			0.115		0.196	0.312	0.508
3	13	44	300	440370			0.114		0.196	0.312	0.508
3	13	88	304	446024			0.114		0.196	0.312	0.508
4	1	44	308	451582			0.114		0.197	0.312	0.509
4	1	88	312	457312			0.114		0.205	0.312	0.517
4	2	44	315	462943			0.114		0.207	0.312	0.519
4	2	88	319	468597			0.114		0.211	0.312	0.523
4	3	44	323	474228			0.114		0.211	0.312	0.523
4	3	88	327	479883			0.114		0.216	0.312	0.528
4	4	44	331	485516			0.114		0.217	0.312	0.529
4	4	88	335	491172			0.114		0.222	0.312	0.534
4	5	44	338	496806			0.114		0.223	0.312	0.535
4	5	88	346	508095			0.114		0.223	0.312	0.535
4	6	44	354	519385			0.114		0.226	0.312	0.538
4	7	88	362	530673			0.114		0.237	0.312	0.549
4	8	44	369	541962			0.114		0.241	0.312	0.553
4	9	88	371	544007			FAILURE		FAILURE	2.800	FAILURE
4	10	16									

FAILURE OF THE SKIN DID NOT OCCUR AT THE RIVET
 LOCATION CONTAINING THE PRE-CRACK

TABLE 8-33. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 63

SPECIMEN NUMBER: 63
 SPECIMEN TYPE: CENTER T
 SKIN/STRINGER S-37-7B S/N 1
 LOAD (KIPS): 219.9
 STRESS (KSI): 30.5
 SPECTRUM: AMAYS
 CYCLES TO FAILURE: 156117
 % LIFE AT FAILURE: 106
 FAILURE LOAD(LBS): 173800
 FINAL CRACK LGTH: 7.2
 HOLE DIA (INCHES): 0.315

LIFF	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		R/BACK	L/BACK	R/FRONT	L/FRONT	TOTAL CRACK LENGTH			
					R/FRONT	L/FRONT					SKIN FRONT	SKIN BACK	STRINGER FRONT	STRINGER BACK
1	1	0	0	0	0.000		0.000				0.315	0.315	0.315	0.315
1	7	88	54	79629					0.122		0.315	0.315	0.437	0.437
1	8	88	62	90319				0.203			0.315	0.518	0.481	0.481
1	9	88	69	101611				0.324			0.315	0.639	0.615	0.615
1	10	44	73	107264				0.376			0.315	0.691	0.695	0.695
1	10	88	77	112897				0.452			0.315	0.767	0.792	0.792
1	11	16	78	114837				0.469			0.817	0.784	0.792	0.792
1	11	44	81	118530				0.522			0.884	0.837	0.792	0.792
1	11	88	85	124183				0.609			0.933	0.924	0.792	0.792
1	12	44	88	129336				0.686			1.003	1.001	0.792	0.792
1	12	88	92	135468				0.800			1.107	1.115	0.995	0.995
1	13	44	96	141122				0.923		0.203	1.224	1.238	1.240	1.240
1	13	88	100	146755				1.105		0.448	1.386	1.420	1.240	1.240
2	1	44	104	152303				1.396		0.448	1.679	1.793	1.240	1.240
2	1	61	105	154514			0.082	0.262		0.448	1.900	2.201	1.240	1.240
2	1	64	106	154966			0.390	0.715		0.448	1.993	2.423	1.240	1.240
2	1	67	106	155320			0.519	0.892		0.448	2.051	2.642	1.240	1.240
2	1	70	106	155637			0.715	1.118		0.448	2.217	3.191	1.240	1.240
2	1	70	106	155662			0.892	1.420		0.448	2.517	3.538	1.240	1.240
2	1	72	106	155901			1.118	2.505		0.448	2.650	3.938	1.760	1.760
2	1	73	106	156008			1.420	2.708		0.448	2.831	4.443	1.845	1.845
2	1	73	106	156103			1.512	2.930		0.448	3.073	4.757	1.948	1.948
2	1	73	105	156117			FAILURE	FAILURE	FAILURE	FAILURE	7.200	7.200	FAILURE	FAILURE

TABLE 8-34. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 64

SPECIMEN NUMBER: 64
 SPECIMEN TYPE: CENTER T
 SKIN/STRINGER: S-37-78 S/N 2
 LOAD (KIPS): 219.9
 STRESS (KSI): 36.5
 SPECTRUM: AMMS
 CYCLES TO FAILURE: 204191
 % LIFE AT FAILURE: 139
 FAILURE LOAD(LBS): 146190
 FINAL CRACK LOH: 6.5
 HOLE DIA (INCHES): 0.316

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		SKIN		STRINGER		SKIN		TOTAL CRACK LENGTH	
					R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT	R/FRONT	L/BACK	SKIN FRONT	SKIN BACK
1	1	0	0	0							0.316	0.316	0.316	0.316
1	11	88	85	124176				0.128			0.316	0.316	0.316	0.316
1	12	44	88	129830				0.274			0.316	0.316	0.316	0.316
1	12	88	92	135464				0.331			0.316	0.316	0.316	0.316
1	13	44	96	141118				0.383			0.316	0.316	0.316	0.316
1	13	88	100	146751				0.447			0.316	0.316	0.316	0.316
2	1	44	104	152465				0.501			0.316	0.316	0.316	0.316
2	1	88	108	158033				0.563			0.316	0.316	0.316	0.316
2	2	44	112	163693	0.593			0.621			0.316	0.316	0.316	0.316
2	2	88	115	169327	0.666			0.689			0.909	0.937	0.316	0.316
2	3	44	119	174983	0.742			0.762			0.982	1.005	0.316	0.316
2	3	88	123	180617	0.821			0.829			1.058	1.078	0.316	0.316
2	4	44	131	191905	1.061		0.116	0.889			1.137	1.145	0.316	0.316
2	4	88	135	197560	1.326		0.249	0.889			1.245	1.321	0.316	0.316
2	5	44	136	199101	1.408		0.606	1.336			1.377	1.610	0.316	0.316
2	5	56	137	200900	1.649		0.698	1.423			1.642	2.258	0.316	0.316
2	5	84	138	202399	2.117		0.946	1.685			1.724	2.437	0.316	0.316
2	5	88	138	203193	3.396		1.417	2.193			1.965	2.947	0.316	0.316
2	6	7	139	204003	FAILURE		1.417	3.470			2.433	3.926	0.316	0.316
2	6	8	139	204191	FAILURE		1.147	FAILURE			3.712	5.203	0.316	0.316
2	6	8	139	204191	FAILURE		FAILURE	FAILURE	FAILURE FAILURE2		6.500	6.500	FAILURE	FAILURE

TABLE 8-33. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 65

SPECIMEN NUMBER: 65
 SPECIMEN TYPE: CENTER T - SPLIT SKIN
 SKIN/STRINGER: S-37-9A-S/N 1
 LOAD (PIPS): 21C
 STRESS (KSI): 36.35
 SPECTRUM: AMAVS
 CYCLES TO FAILURE: 259515
 % LIFE AT FAILURE: 177
 FAILURE LOAD(LBS): N/A
 FINAL CRACK LGTH: 2.3
 HOLE DIA (INCHES): 0.314

LIFE	PASS	BLOCK	% OF LIFE	SKIN		CYCLES	SKIN		R/BACK	L/BACK	STRINGER		TOTAL CRACK LENGTH	
				R/FRONT	L/FRONT		R/BACK	L/BACK			R/FRONT	L/FRONT	SKIN FRONT	SKIN BACK
1	1	0	0			0					0.000		0.314	0.314
1	9	88	69	101612		101612					0.128		0.314	0.442
1	10	44	73	107265		107265					0.172		0.314	0.486
1	10	88	77	112899		112899					0.209		0.314	0.523
1	11	44	81	118553		118553					0.245		0.314	0.559
1	11	88	85	124186		124186					0.292		0.314	0.606
1	12	44	88	129840		129840					0.329		0.314	0.643
1	12	88	92	135473		135473					0.372		0.314	0.686
1	13	44	96	141127		141127					0.413		0.314	0.727
1	13	88	100	146760		146760					0.457		0.314	0.771
2	1	44	104	152415		152415					0.476		0.314	0.790
2	1	88	108	158048		158048					0.502		0.314	0.816
2	5	88	138	203200		203200		0.105			0.502		0.314	0.816
2	6	44	142	208855		208855		0.125			0.502		0.314	0.816
2	6	88	146	214488		214488		0.151			0.502		0.314	0.816
2	7	44	150	220144		220144		0.173			0.502		0.314	0.816
2	7	88	154	225777		225777		0.199			0.502		0.314	0.816
2	8	44	158	231433		231433		0.226			0.502		0.314	0.816
2	8	88	162	237067		237067		0.266			0.923		0.314	0.816
2	9	44	165	242721		242721		0.297			1.042		0.314	1.356
2	9	88	169	248357		248357		0.317		0.167	1.233		0.314	1.714
2	10	39	173	253367		253367		0.396		0.456	1.390		0.314	2.160
2	10	66	175	256835		256835		0.459		FAILURE	FAILURE		0.314	FAILURE
2	10	87	177	259502		259502							0.314	1.628
2	10	87	177	259515		259515							0.314	2.300

THE CONSTANT VALUE OF .502 FOR THE LEFT FRONT CRACK ON THE STRINGER IS AN ESTIMATED VALUE BETWEEN CYCLES 203200 AND 231433.

TABLE 8-36. STRAIN SURVEY OF SPECIMEN NO. 66

SPECIMEN NUMBER: 66
 SPECIMEN TYPE: CENTER T - SPLIT

SPECTRUM:

AMAYS

6.5

CYCLES TO FAILURE: 101023

APPLIED LOAD(LBS): 132000

CYCLES	% OF LIVE	CRACK LENGTH		GAGE 1 L/SKIN	GAGE 2 L/SKIN	GAGE 3 L/STRING	S T R A I N		(M I C R O I N C H E S / I N C H)					GAGE 10 R/B/SKIN	GAGE 11 R/B/SKIN
		SKIN INCHES	STRINGER INCHES				GAGE 4 C/STRING	R/SKIN	GAGE 5 R/STRING	R/SKIN	GAGE 6 R/SKIN	R/SKIN	GAGE 7 R/SKIN		
0	0	0.000	0.000	1758	1707	1581	1268		1756	1879	1803	1831	1850	1853	
53865	23	0.000	0.000	1738	1717	OFFSCALE	1274		1767	2531	1809	1836	1647	2615	
67732	46	0.523	0.000	1735	1713	OFFSCALE	1254		1774	2925	1815	1856	4494	9253	
74427	51	0.563	0.000	1732	1707	OFFSCALE	1247		1777	2995	1816	1859	OFFSCALE	OFFSCALE	
74427	51	0.563	0.000	1731	1746	1630	1293	1584	1748	1767	1795	1806	GAGE FAIL	INCORECT	
79020	54	0.642	0.000	1797	1747	1300	1280	1588	1754	1770	1801	1817			
84579	58	0.890	0.494	1783	1698	2242	1248	1608	1770	1779	1815	1848			
90312	61	0.890	0.414	1777	1679	2928	1252	1627	1772	1782	1811	1840			
95969	65	1.141	0.536	1769	1638	4148	1212	1629	1777	1786	1816	1861			
99442	68	1.878	0.618	1741	OFFSCALE		1149	1732	1834	1812	1854	1928			
100015	68	2.091	0.648	1734	1094		1094	1784	1858	1818	1863	1959			
100227	68	2.276	0.646	1738	1077		1077	1799	1868	1833	1872	1973			
100333	68	2.590	0.649	1738	1049		1049	1844	1889	1847	1885	1990			
100357	68	2.820	0.654	1738	1015		1015	1896	1917	1849	1903	2021			
100482	68	3.038	0.662	1750	981		981	1944	1941	1859	1921	2052			
100590	68	3.292	0.670	1768	957		957	1984	1965	1372	1940	2078			
100695	69	3.741	0.673	1812	909		909	2059	1991	1901	1952	2086			
100799	69	3.894	0.578	1828	894		894	2092	2015	1897	1978	2127			
100812	59	4.254	0.692	1900	856		856	2165	2042	1915	2010	2166			
100898	69	4.539	0.692	1973	813		813	2218	2048	1934	2009	2157			
100904	69	6.382	FAILURE	3915	645		645	2549	2216	1986	2182	2442			

SOME DIFFICULTY WAS ENCOUNTERED IN OBTAINING EARLY STRAIN DATA
 A NEW CALIBRATION WAS MADE AT 74427 CYCLES

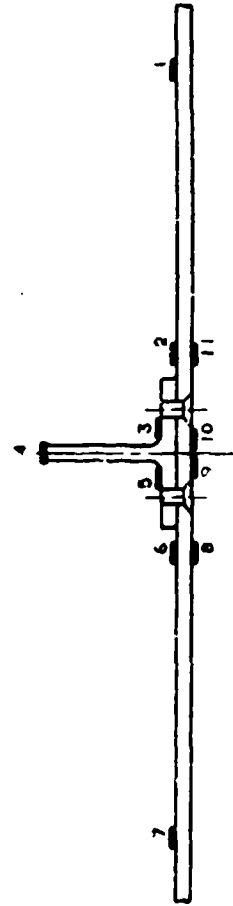


TABLE 8-37. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 66

SPECIMEN NUMBER: 66
 SPECIMEN TYPE: CENTER T - SPLIT SKIN
 SKIN/STRINGER: S-37-9A S/N 2
 LOAD (KIPS): 218
 STRESS (KSI): 30.35
 SPECTRUM: AMMS
 CYCLES TO FAILURE: 101023
 % LIFE AT FAILURE: 84
 FAILURE LOAD(LBS): N/A
 FINAL CRACK LGTH: 6.5
 HOLE DIA (INCHES): 0.313

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		SKIN		STRINGER		TOTAL CRACK LENGTH		
					R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT	SKIN FRONT	SKIN BACK	STRINGER FRONT
1	1	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.313	0.313	0.313
1	6	88	46	67732			0.210				0.313	0.523	0.313
1	7	53	51	74427			0.250				0.313	0.563	0.313
1	7	88	54	79020			0.329				0.313	0.642	0.313
1	8	44	58	84679			0.577			0.153	0.313	0.890	0.466
1	8	88	62	90313			0.577			0.181	0.313	0.890	0.494
1	9	44	65	95969			0.577			0.223	0.313	1.141	0.536
1	9	71	68	99442			0.577	0.251		0.305	1.236	1.878	0.618
1	9	76	68	100015	0.913		0.577	0.988		0.335	1.469	2.091	0.648
1	9	78	68	100227	1.156		0.577	1.201		0.333	1.670	2.276	0.646
1	9	78	68	100333	1.357		0.577	1.386		0.336	1.959	2.590	0.649
1	9	79	68	100357	1.646		0.577	1.700		0.341	2.135	2.820	0.654
1	9	80	69	100482	1.822		0.577	1.930		0.349	2.371	3.038	0.662
1	9	80	69	100590	2.058		0.577	2.148		0.357	2.639	3.292	0.670
1	9	81	69	100695	2.326		0.577	2.402		0.360	3.021	3.741	0.673
1	9	82	69	100799	2.708		0.577	2.851		0.365	3.239	3.894	0.678
1	9	82	69	100812	2.926		0.577	3.004		0.379	3.510	4.254	0.692
1	9	83	69	100908	3.197		0.577	3.364		0.379	3.779	4.539	0.692
1	9	83	69	100904	3.466		0.577	3.649		FAILURE	5.499	6.382	FAILURE
1	9	83	69	100913	5.186		0.577	5.492		FAILURE	6.500	6.500	FAILURE
1	9	84	69	101023	FAILURE	FAILURE	FAILURE	FAILURE					

TABLE 8-38. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 67

SPECIMEN NUMBER: 67										
SPECIMEN TYPE: CENTER T - SPLIT SKIN										
SKIN/STRINGER: S-37-9B S/N 1										
LOAD (KIPS): 218										
STRESS (KSI): 30.35										
SPECTRUM: ANAVS										
CYCLES TO FAILURE: 152511										
% LIFE AT FAILURE: 104										
FAILURE LOAD(LBS): N/A										
FINAL CRACK LGTH: 2.5										
HOLE DIA (INCHES): 0.315										
LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN R/FRONT	SKIN L/FRONT	SKIN R/BACK	SKIN L/BACK	STRINGER R/FRONT L/FRONT	TOTAL CRACK LENGTH SKIN FRONT SKIN BACK STRINGER FRONT
1	1	0	0	0						0.315 0.315 0.315
1	5	88	38	56443			0.000	0.092		0.315 0.407 0.315
1		88	54	79022			0.098	0.098		0.315 0.413 0.315
1	4	88	62	90311			0.100	0.100		0.315 0.415 0.315
1	9	44	65	95966			0.197	0.197		0.315 0.512 0.315
1	9	88	69	101600			0.260	0.260		0.315 0.575 0.315
1	10	44	73	107253			0.321	0.321		0.315 0.636 0.315
1	10	88	77	112886			0.398	0.398		0.315 0.713 0.315
1	11	44	81	118539	0.524		0.466	0.466		0.315 0.781 0.315
1	11	88	85	124172	0.592		0.560	0.560		0.315 0.875 0.315
1	12	44	88	129825	0.664		0.650	0.650		0.315 0.965 0.315
1	12	88	92	135459	0.794		0.782	0.782	0.181	0.315 1.109 0.496
1	13	44	96	141112	0.981		0.956	0.956	0.261	0.315 1.296 0.576
1	13	88	100	146745	1.314		1.315	1.315	0.473	0.315 1.629 0.788
2	1	22	102	149573	1.456		FAILURE	FAILURE	FAILURE	1.771 1.776 FAILURE
2	1	44	104	152400	FAILURE		FAILURE	FAILURE	FAILURE	2.500 2.500 FAILURE
2	1	45	104	152511	FAILURE		FAILURE	FAILURE	FAILURE	2.500 2.500 FAILURE

TABLE 8-39. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 68

SPECIMEN NUMBER: 68
 SPECIMEN TYPE: CENTER T - SPLIT SKIN
 SKIN/STRINGER: 3-37-98 S/N 2
 LOAD (KIPS): 218
 STRESS (KSI): 30.35
 SPECTRUM: AMVS
 CYCLES TO FAILURE: 176213
 % LIFE AT FAILURE: 120
 FAILURE LOAD (LBS): 172810
 FINAL CRACK LGTH: 1.8
 HOLE DIA (INCHES): 0.314

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		SKIN		STRINGER	TOTAL CRACK LENGTH	
					R/FRONT	L/FRONT	R/BACK	L/BACK		SKIN FRONT	SKIN BACK
1	1	0	0	0					0.000	0.314	0.314
1	11	88	85	124169					0.129	0.314	0.314
1	12	44	88	129822					0.159	0.314	0.443
1	12	88	92	135456					0.207	0.314	0.473
1	13	44	96	141109				0.160	0.239	0.314	0.521
1	13	88	100	146743				0.240	0.289	0.314	0.553
2	1	44	104	152399				0.302	0.348	0.314	0.603
2	1	88	108	158032				0.385	0.459	0.314	0.662
2	2	44	112	163688	0.485			0.465	0.459	0.314	0.699
2	2	88	115	169321	0.598			0.607	FAILURE	0.799	0.773
2	3	44	119	174977	0.785			0.783	FAILURE	0.921	FAILURE
2	3	53	120	176014	FAILURE			0.200	FAILURE	1.099	1.097
2	3	54	120	176213	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	1.800	1.800

TABLE 8-40. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 69

SPECIMEN NUMBER: 69										CYCLES TO FAILURE: 285354			
SPECIMEN TYPE: S-39-11A S/N 1										% LIFE AT FAILURE: 194			
SKIN/STRINGER:										FAILURE LOAD(LBS): N/A			
LOAD (KIPS): 220										FINAL CRACK LGTH: 8			
STRESS (KSI): 21.48										HOLE DIA (INCHES): 0.324			
SPECTRUM :										ANAVS			
LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN R/FRONT	SKIN L/FRONT	R/BACK	L/BACK	STRINGER R/FRONT	STRINGER L/FRONT	SKIN FRONT	SKIN BACK	STRINGER FRONT
1	1	0	0	0	0.000		0.000		0.000		0.324	0.324	0.324
1	13	88	100	146751	0.086		0.086		0.196		0.324	0.410	0.520
2	1	88	108	158038	0.179		0.179		0.262		0.324	0.503	0.586
2	2	44	112	163694	0.222		0.222		0.288		0.324	0.546	0.612
2	2	88	115	169327	0.262		0.262		0.343		0.324	0.586	0.667
2	2	44	119	174982	0.297		0.297		0.399		0.324	0.621	0.723
2	3	88	123	180617	0.337		0.337		0.500		0.324	0.661	0.824
2	2	44	127	186270	0.384		0.384		0.613		0.324	0.708	0.937
2	2	88	131	191903	0.431		0.431		0.613		0.324	0.755	0.937
2	2	44	135	197558	0.477		0.477		0.613		0.324	0.801	0.937
2	2	88	138	203192	0.529		0.529		0.613		0.324	0.853	0.937
2	2	44	142	208847	0.574		0.574		0.613		0.324	0.898	0.937
2	2	88	146	214481	0.635		0.635		0.613		0.324	0.959	0.937
2	2	44	150	220136	0.688	0.693	0.688		0.613		1.017	1.012	0.937
2	2	88	154	225768	0.753	0.753	0.754		0.613		1.077	1.078	0.937
2	2	44	158	231423	0.813	0.813	0.825		0.613		1.137	1.149	0.937
2	2	88	162	237057	0.873	0.873	1.031		0.613		1.197	1.355	0.937
2	2	44	165	242711	0.948	0.948	1.106		0.613		1.272	1.430	0.937
2	2	88	169	248344	1.039	1.039	1.195		0.613		1.363	1.519	0.937
2	2	44	173	253997	1.117	1.117	1.267		0.613		1.441	1.591	0.937
2	2	88	177	259630	1.220	1.220	1.350		0.613		1.544	1.674	0.937
2	2	44	181	265284	1.323	1.323	1.464		0.613		1.647	1.788	0.937
2	2	88	185	270917	1.474	1.474	1.454		0.613	0.274	1.798	1.778	1.211
2	2	44	187	273744	1.534	1.534	1.504		0.613	0.380	1.858	1.828	1.317
2	2	88	188	276571	1.633	1.633	1.607		0.613	0.582	1.957	1.931	1.519
2	2	44	190	279397	1.750	1.750	1.729	0.106	0.613	0.778	2.074	2.159	1.715
2	2	87	192	282083	2.533	2.533	2.462	0.802	0.613	0.770	2.857	3.588	1.715
2	2	15	193	283202	2.767	2.767	2.735	0.802	0.613	0.778	3.091	3.861	1.715
2	2	44	194	284122	3.054	3.054	3.044	0.802	0.613	0.778	3.378	4.170	1.715
2	2	88	194	284352	3.485	3.485	3.463	0.802	0.613	0.778	3.809	4.589	1.715
2	2	44	194	285031	4.667	4.667	4.697	0.802	0.613	0.778	4.991	5.823	1.715
2	2	88	194	285151	5.252	5.252	5.276	0.802	0.613	0.778	5.576	6.402	1.715
2	2	44	194	285346	6.320	6.320	6.322	0.802	0.613	0.778	6.644	7.448	1.715
2	2	88	194	285354	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	8.000	8.000	FAILURE

TABLE 8-41. STRAIN SURVEY OF SPECIMEN NO. 70

SPECIMEN NUMBER: 70
SPECIMEN TYPE: THICK EDGE L

SPECTRUM:
FINAL CRACK LGTH:

AMAVS
5.8

CYCLES TO FAILURE: 234218
APPLIED LOAD(LBS): 132000

CYCLES	% OF LIFE	CRACK LENGTH		GAGE 1 L/STRING	GAGE 2 L/STRING	GAGE 3 SKIN/RF	S T R A I N		(M I C R O I N C H E S / I N C H)		GAGE 9 C/BACK	GAGE 10 R/BACK	GAGE 11 R/BACK	
		SKIN INCHES	STRINGER INCHES				GAGE 4 R/STRING	GAGE 5 R/STRING	GAGE 6 L/BACK	GAGE 7 L/BACK				GAGE 8 L/BACK
0	0	0.000	0.000	982	1263	1426	1253	1048	1408	1335	1448	1468	1432	1364
33864	23	0.000	0.000	948	1235	1467	1276	1025	1464	1387	1497	1494	1461	1391
79022	54	0.000	0.000	942	1231	1477	1283	1021	1460	1400	1497	1494	1463	1392
112883	77	0.000	0.000	945	1233	1511	1325	1027	1459	1422	1500	1498	1469	1396
124169	84	0.000	0.490	947	1237	1529	1347	1032	1452	1440	1505	1501	1472	1400
129822	89	0.463	0.527	940	1228	1532	1352	1023	1450	1453	1509	1499	1466	1390
135456	92	0.499	0.571	938	1228	1533	1354	1027	1436	1474	1504	1491	1462	1388
141110	96	0.545	0.605	933	1222	1545	1361	1023	1441	1491	1512	1493	1461	1383
146743	100	0.586	0.655	932	1222	1566	1378	1029	1425	1501	1513	1488	1457	1382
152397	104	0.628	0.762	930	1220	1591	1417	1029	1422	1510	1516	1491	1458	1380
158031	108	0.650	0.950	930	1221	1646	1514	1071	1401	1577	1577	1493	1456	1381
163685	111	0.725	0.950	926	1216	1662	1521	1065	1400	1581	1580	1493	1455	1376
169318	115	0.782	0.950	925	1216	1674	1530	1066	1388	1590	1588	1487	1450	1376
174974	119	0.835	0.950	923	1214	1698	1537	1064	1403	1612	1613	1490	1452	1372
180608	123	0.897	0.950	927	1219	1734	1554	1072	1405	1625	1648	1492	1453	1378
186263	127	0.964	0.950	930	1221	1777	1558	1077	1415	1652	1694	1500	1460	1380
191896	131	1.029	0.950	933	1225	1866	1579	1084	1406	1658	1749	1500	1460	1385
197551	134	1.105	0.950	932	1223	1959	1580	1083	1412	1690	1841	1505	1463	1382
203184	138	1.191	0.950	933	1226	2191	1613	1092	1407	1703	2061	1504	1464	1386
208639	142	1.281	0.950	931	1221	2664	1636	1090	1407	1744	2594	1506	1463	1382
214472	146	1.375	0.950	935	1227	4268	1951	1109	1398	1766	4966	1511	1466	1387
220127	150	1.508	1.365	937	1230	OFFSCALE	OFFSCALE	1193	1436	1723	OFFSCALE	1530	1473	1388
225761	154	1.699	2.450	941	1237	OFFSCALE	OFFSCALE	1429	1447	2375		1554	1479	1393

BETWEEN CYCLES 208839 AND 214472 THE FATIGUE CRACK PASSED GAGES 3 AND 8
BETWEEN CYCLES 214472 AND 220127 THE FATIGUE CRACK PASSED GAGE 4

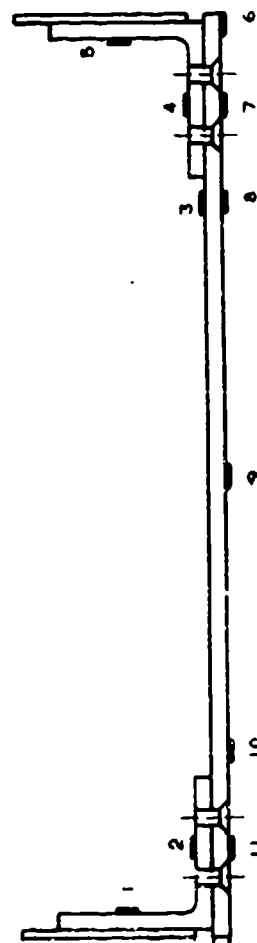


TABLE 8-42. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 70

SPECIMEN NUMBER: 70				CYCLES TO FAILURE: 234218							
SPECIMEN TYPE: EDGE L				% LIFE AT FAILURE: 160							
SKIN/STRINGER: S-39-11A S/N 2				FAILURE LOAD(LBS): N/A							
LOAD (KIPS): 220				FINAL CRACK LGTH: 5.8							
STRESS (KSI): 21.48				HOLE DIA (INCHES): 0.313							
SPECTRUM :											
LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN R/FRONT	SKIN L/BACK	STRINGER R/FRONT	STRINGER L/FRONT	SKIN FRONT	SKIN BACK	TOTAL CRACK LENGTH
1	1	0	0	0					0.313	0.313	0.313
1	11	88	85	124169	0.000	0.000		0.177	0.313	0.313	0.490
1	12	44	88	129822	0.150	0.150		0.214	0.313	0.463	0.527
1	12	88	92	135456	0.186	0.186		0.258	0.313	0.499	0.571
1	13	44	96	141110	0.232	0.232		0.292	0.313	0.545	0.605
1	13	88	100	146743	0.273	0.273		0.342	0.313	0.586	0.655
2	1	44	104	152397	0.315	0.315		0.449	0.313	0.628	0.762
2	1	88	108	158031	0.337	0.337		0.637	0.313	0.650	0.950
2	2	44	112	163685	0.412	0.412		0.637	0.313	0.725	0.950
2	2	88	115	169318	0.469	0.469		0.637	0.313	0.782	0.950
2	3	44	119	174974	0.522	0.522		0.637	0.313	0.835	0.950
2	3	88	123	180608	0.584	0.584		0.637	0.313	0.897	0.950
2	4	44	127	186263	0.651	0.651		0.637	0.993	0.964	0.950
2	4	88	131	191896	0.680	0.716		0.637	1.055	1.029	0.950
2	5	44	135	197551	0.742	0.792		0.637	1.100	1.105	0.950
2	5	88	138	203184	0.901	0.878		0.637	1.214	1.191	0.950
2	6	44	142	208839	0.986	0.968		0.637	1.299	1.281	0.950
2	6	88	146	214472	1.094	1.062		0.637	1.407	1.375	0.950
2	7	44	150	220127	1.229	1.195	0.415	0.637	1.542	1.508	1.365
2	7	88	154	225761	1.406	1.386	1.500	0.637	1.719	1.699	2.450
2	8	66	160	234218	FAILURE	FAILURE	FAILURE	FAILURE	5.800	5.800	FAILURE

TABLE 8-43. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 71

SPECIMEN NUMBER: 71
 SPECIMEN TYPE: EDGE L
 SKIN/STRINGER: S-39-11B S/N 1
 LOAD (KIPS): 220
 STRESS (KSI): 21.48
 SPECTRUM: AMAVS
 CYCLES TO FAILURE: 629051
 % LIFE AT FAILURE: 421
 FAILURE LOAD (LBS): N/A
 FINAL CRACK LGTH: 3.7
 HOLE DIA (INCHES): 0.313

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		R/BACK	L/BACK	R/FRONT	STRINGER		TOTAL CRACK LENGTH	
					R/FRONT	L/FRONT				R/FRONT	L/FRONT	SKIN FRONT	SKIN BACK
1	1	0	0	0								0.313	0.313
4	4	88	331	496676			0.000	0.140				0.313	0.453
4	5	88	338	507964			0.168	0.216				0.313	0.481
4	6	88	346	519253			0.216	0.279				0.313	0.529
4	7	88	354	530541			0.279	0.358				0.313	0.592
4	8	88	362	541830			0.358	0.438				0.313	0.671
4	9	88	369	553118			0.438	0.520		0.149		0.313	0.751
4	10	88	377	564404			0.520	0.601		0.149		0.313	0.833
4	11	88	385	575691			0.601	0.785		0.239		0.313	0.914
4	12	88	392	586977			0.785	1.432		0.320		0.313	1.098
4	13	88	400	598263			1.432	0.438		0.380		0.313	2.183
4	14	9	401	599301			0.438	0.800		0.421		0.313	2.545
4	15	88	415	620836			0.800	1.432		0.421	0.173	0.313	2.545
4	16	33	418	625002			0.800	1.432		0.421	0.749	0.313	2.545
4	16	65	421	629051			FAILURE	FAILURE	FAILURE	FAILURE	FAILURE	3.700	3.700

TABLE 8-44. CRACK GROWTH MEASUREMENTS OF SPECIMEN NO. 72

SPECIMEN NUMBER: 72
 SPECIMEN TYPE: EDGE L
 SKIN/STRINGER: S-33-11B S/N 2
 LOAD (KIPS): 220
 STRESS (KSI): 21.48
 SPECTRUM: AMMS
 CYCLES TO FAILURE: 441256
 % LIFE AT FAILURE: 301
 FAILURE LOAD(LBS): N/A
 FINAL CRACK LGTH: 2.4
 HOLE DIA (INCHES): 0.313

LIFE	PASS	BLOCK	% OF LIFE	CYCLES	SKIN		SKIN		STRINGER		TOTAL CRACK LENGTH	
					R/FRONT	L/FRONT	R/BACK	L/BACK	R/FRONT	L/FRONT	SKIN FRONT	SKIN BACK
1	1	0	0	0					0.000		0.313	0.313
2	4	88	131	191898					0.150		0.313	0.463
2	5	88	138	203187					0.196		0.313	0.509
2	6	88	146	214476					0.293		0.313	0.606
2	7	88	154	225764					0.274		0.313	0.587
2	8	88	162	237053					0.300		0.313	0.613
2	9	88	169	248341					0.328		0.313	0.641
2	10	88	177	259628					0.371		0.313	0.684
2	11	88	185	270915					0.374		0.313	0.687
2	12	88	192	282201					0.403		0.313	0.716
2	13	88	200	293488					0.413		0.313	0.726
3	1	88	208	304777					0.422		0.313	0.735
3	2	88	215	316066					0.464		0.313	0.777
3	3	88	223	327355					0.488		0.313	0.801
3	4	88	231	338644					0.488		0.313	0.801
3	7	88	254	372509					0.488	0.187	0.313	0.988
3	8	61	259	380319					0.488	0.422	0.313	1.223
3	8	88	262	383798					0.488	0.774	0.313	1.575
3	10	88	277	406373					0.448	0.774	0.313	1.535
3	11	44	281	412027			0.085		0.448	0.774	0.313	1.535
3	11	88	285	417660			0.184		0.448	0.774	0.313	1.535
3	12	44	288	423313			0.293		0.448	0.774	0.313	1.535
3	12	88	292	428947			0.334		0.448	0.774	0.313	1.535
3	12	88	292	428947			0.579		0.448	0.774	0.313	1.535
3	13	35	295	433327			1.155		0.448	0.774	0.313	1.535
3	13	88	300	440233			1.222		0.448	0.774	0.313	1.535
4	1	8	301	441256			FAILURE	FAILURE	FAILURE	FAILURE	2.400	FAILURE

APPENDIX A

A-1 INTRODUCTION

Appendix A presents the randomized loading spectra of the A-10A and the AMAVS Flight Spectrum. The loading sequences, as they are described in the Appendix, represent one block (Pass) of repeated loading. The loading conditions are normalized about 100% of maximum loads. They are proportionally applied during the shear-lap and the stringer reinforced test program.

A-1.1 'A-10A' LOADING SPECTRUM

The A-10A randomized flight-by-flight loading spectrum is presented in Tables A-1 through A-3. Table A-1 provides a listing of 219 flight and ground conditions. The loading conditions are normalized about condition No. 64. Table A-2 presents the randomized conditions and the number of occurrences associated with each condition. One pass of randomized loading represents 4% of life or 240 hours of flight and ground conditions. There are 7416.5 cycles per one block which is equal to 120 flights. Table A-3 presents the marker band block (=4%) used during the test program. Table A-4 presents the sequences of the marker band application within one (1) life time of the A-10A spectrum.

A-1.2 'AMAVS' LOADING SPECTRUM

The randomized loading conditions of the AMAVS flight and ground spectrum is presented in Table A-5. One block (Pass) of Table A-5 represents 7.8125% of one life. The total number of cycles in one block is 11245 cycles, which is equal to 100 flights of the AMAVS spectrum. One life of the AMAVS is equal to 13500 flight hours. Each block contains marker band cycles inserted within it. The loading conditions at Table A-5 were normalized about condition No. 17.

TABLE A-1. A-10A NORMALIZED LOADING CONDITIONS

1	9.95	-4.66	9.95
2	9.83	0.10	9.83
3	9.95	0.20	9.95
4	10.01	0.28	10.01
5	9.83	24.44	9.83
6	9.95	24.54	9.95
7	10.01	24.62	10.01
8	9.83	29.28	9.83
9	9.95	29.40	9.95
10	10.01	29.46	10.01
11	9.83	34.16	9.83
12	9.95	34.27	9.95
13	10.01	34.34	10.01
14	9.83	39.03	9.83
15	9.95	39.13	9.95
16	10.01	39.21	10.01
17	9.95	44.02	9.95
18	10.01	44.07	10.01
19	9.95	48.88	9.95
20	10.01	48.93	10.01
21	9.95	53.74	9.95
22	10.01	53.79	10.01
23	9.95	58.60	9.95
24	10.01	58.66	10.01
25	9.95	63.47	9.95
26	9.95	68.33	9.95
27	10.01	68.41	10.01
28	10.01	87.86	10.01
29	10.01	92.72	10.01
30	11.94	-17.39	11.94
31	11.84	-11.63	11.84
32	11.94	-11.51	11.94
33	11.84	-5.78	11.84
34	11.94	-5.65	11.94
35	12.02	-5.60	12.02
36	11.84	0.10	11.84
37	11.94	0.20	11.94
38	12.02	0.28	12.02
39	11.84	29.43	11.84
40	11.94	29.53	11.94
41	12.02	29.61	12.02
42	11.84	35.29	11.84
43	11.94	35.41	11.94
44	12.02	35.46	12.02
45	11.84	41.17	11.84
46	11.94	41.27	11.94
47	12.02	41.34	12.02
48	11.94	47.15	11.94
49	12.02	47.20	12.02
50	11.94	52.98	11.94
51	12.02	53.08	12.02
52	11.94	58.88	11.94
53	12.02	58.94	12.02
54	11.94	64.71	11.94
55	12.02	64.79	12.02

56	11.94	70.60	11.94
57	12.02	70.67	12.02
58	11.94	76.43	11.94
59	12.02	76.53	12.02
60	11.94	82.33	11.94
61	12.02	82.41	12.02
62	12.02	88.26	12.02
63	12.02	94.14	12.02
64	12.02	100.00	12.02
65	12.12	-5.73	12.12
66	11.99	0.10	11.99
67	12.12	0.20	12.12
68	12.19	0.28	12.19
69	11.99	29.84	11.99
70	12.12	29.96	12.12
71	12.19	30.02	12.19
72	11.99	35.79	11.99
73	12.12	35.90	12.12
74	12.19	35.97	12.19
75	12.12	41.85	12.12
76	12.19	41.90	12.19
77	12.12	47.81	12.12
78	12.19	47.86	12.19
79	12.12	53.74	12.12
80	12.19	53.82	12.19
81	12.12	59.70	12.12
82	12.19	59.75	12.19
83	12.12	65.63	12.12
84	12.19	65.71	12.19
85	12.12	71.59	12.12
86	12.19	71.64	12.19
87	12.19	77.60	12.19
88	12.19	83.55	12.19
89	13.90	-6.62	13.90
90	13.90	0.10	13.90
91	13.90	34.65	13.90
92	14.08	34.83	14.08
93	14.03	41.68	14.03
94	14.08	41.73	14.08
95	14.03	48.57	14.03
96	14.08	48.63	14.08
97	14.03	55.47	14.03
98	14.08	55.55	14.08
99	14.03	62.37	14.03
100	14.08	62.45	14.08
101	14.03	69.30	14.03
102	14.08	76.27	14.08
103	9.83	9.83	9.83
104	9.95	9.95	9.95
105	10.01	10.01	10.01
106	9.83	9.83	9.83
107	9.95	9.95	9.95
108	10.01	10.01	10.01
109	9.83	9.83	9.83
110	9.95	9.95	9.95

111	10.01	10.01	10.01
112	9.83	9.83	9.83
113	9.95	9.95	9.95
114	11.99	11.99	11.99
115	12.12	12.12	12.12
116	12.19	12.17	12.19
117	11.99	11.99	11.99
118	12.12	12.12	12.12
119	12.19	12.17	12.19
120	11.99	11.99	11.99
121	12.12	12.12	12.12
122	11.99	11.99	11.99
123	12.12	12.12	12.12
124	12.17	12.17	12.17
125	11.99	11.99	11.99
126	12.12	12.12	12.12
127	12.17	12.17	12.17
128	9.83	24.44	9.83
129	9.95	24.54	9.95
130	10.01	24.62	10.01
131	9.83	29.28	9.83
132	9.95	29.40	9.95
133	10.01	29.46	10.01
134	9.83	34.16	9.83
135	9.95	34.27	9.95
136	10.01	34.34	10.01
137	9.83	39.03	9.83
138	9.95	39.13	9.95
139	10.01	39.21	10.01
140	9.95	44.02	9.95
141	9.95	48.88	9.95
142	9.95	53.72	9.95
143	10.01	53.79	10.01
144	9.95	63.17	9.95
145	10.01	78.13	10.01
146	9.83	24.44	9.83
147	9.95	24.54	9.95
148	9.83	29.40	9.83
149	9.95	29.28	9.95
150	11.99	29.84	11.99
151	12.12	29.96	12.12
152	12.19	30.02	12.19
153	11.99	35.79	11.99
154	12.12	35.90	12.12
155	12.19	35.97	12.19
156	11.99	41.73	11.99
157	12.12	41.85	12.12
158	12.19	41.90	12.19
159	12.12	47.81	12.12
160	12.19	47.86	12.19
161	12.12	53.74	12.12
162	12.19	53.82	12.19
163	12.12	59.70	12.12
164	12.19	59.75	12.19
165	12.12	65.63	12.12

166	12.19	65.71	12.19
167	12.12	71.59	12.12
168	12.19	71.66	12.19
169	12.12	77.55	12.12
170	12.19	77.60	12.19
171	12.12	83.48	12.12
172	12.19	83.55	12.19
173	11.99	29.84	11.99
174	12.12	29.96	12.12
175	12.19	30.02	12.19
176	11.99	35.77	11.99
177	12.12	35.90	12.12
178	12.19	35.97	12.19
179	11.99	41.73	11.99
180	12.12	41.85	12.12
181	12.19	41.90	12.19
182	12.12	47.81	12.12
183	12.19	47.86	12.19
184	12.12	53.74	12.12
185	12.12	59.70	12.12
186	12.12	65.63	12.12
187	12.19	65.68	12.19
188	12.12	71.59	12.12
189	12.19	83.55	12.19
190	9.83	24.44	9.83
191	9.95	24.54	9.95
192	10.01	24.62	10.01
193	11.84	29.43	11.84
194	11.94	29.53	11.94
195	12.02	29.61	12.02
196	11.99	29.84	11.99
197	12.12	29.99	12.12
198	12.19	30.02	12.19
199	13.90	34.65	13.90
200	14.08	34.83	14.08
201	10.01	97.61	10.01
202	12.19	89.49	12.19
203	14.08	83.17	14.08
204	11.84	-23.37	11.84
205	11.84	-23.24	11.84
206	3.56	9.60	3.56
207	3.56	9.16	3.56
208	3.56	8.02	3.56
209	3.56	8.71	3.56
210	3.56	1.96	3.56
211	7.13	4.56	7.13
212	7.13	5.65	7.13
213	3.56	-0.25	3.56
214	7.13	0.56	7.13
215	7.13	3.92	7.13
216	3.56	1.93	3.56
217	3.56	1.58	3.56
218	0.0	0.0	0.0
219	11.94	11.94	11.94

TABLE A-2. A-10A RANDOMIZED LOADING SPECTRUM

115	1	153	1	123	1	116	1	196	1
167	1	115	1	155	1	115	1	119	1
114	1	151	1	125	1	115	2	154	1
69	1	123	1	115	1	157	1	114	1
124	2	69	1	122	1	40	1	55	1
59	1	48	1	43	1	58	1	44	1
194	1	43	1	49	1	40	1	48	1
55	1	52	1	46	1	55	1	43	3
52	1	46	1	39	1	52	1	46	1
44	1	47	1	194	1	38	1	40	1
46	1	54	1	50	1	48	1	43	1
40	1	56	1	52	2	48	1	43	1
194	1	53	1	49	1	5	3	103	2
208	1	210	1	213	3	210	1	213	1
210	1	213	1	126	1	69	1	123	1
115	1	69	1	196	1	69	1	154	1
124	1	115	1	123	1	72	1	115	1
124	1	157	1	123	1	126	1	151	1
119	1	115	1	116	1	157	1	175	1
69	1	123	1	50	1	43	1	37	1
49	1	40	1	46	1	48	1	194	1
37	1	43	1	44	1	40	1	44	1
40	1	195	1	46	1	48	1	46	1
40	1	48	2	50	1	195	1	42	1
46	1	59	1	43	1	59	1	194	1
44	1	48	1	194	1	61	1	43	1
47	1	40	1	43	1	46	1	56	1
61	1	41	1	37	1	50	1	103	1
128	1	19	1	112	1	5	1	208	1
210	1	213	3	210	1	213	1	210	1
213	1	69	1	116	2	118	1	123	1
151	1	163	1	124	1	123	1	124	1
159	1	196	1	115	1	123	1	115	1
124	1	118	1	115	3	196	1	124	1
69	1	115	2	46	1	53	1	194	1
40	1	52	1	43	1	219	1	37	1
52	1	38	1	48	1	44	1	39	1
47	1	57	1	49	1	64	1	40	1
43	1	38	1	194	1	43	1	41	1
194	1	46	1	49	1	51	1	48	1
59	1	46	1	44	1	60	1	55	1
46	1	53	1	43	1	44	1	40	1
54	1	56	1	43	1	56	1	48	1
195	1	14	1	8	1	5	1	103	1
5	1	8	1	208	1	210	1	213	3
210	1	213	1	210	1	213	1	114	1
123	1	114	1	153	1	150	1	114	1
118	1	165	1	114	1	123	2	115	1
114	1	115	2	123	1	122	1	125	1
126	1	125	1	151	1	159	1	115	2
123	1	165	1	118	1	46	1	36	1
39	1	42	1	43	1	42	1	43	1
39	1	46	1	50	1	46	1	42	1
40	1	39	1	46	2	46	2	49	1
56	1	43	1	52	1	48	1	43	1

52	1	43	1	39	2	52	1	43	1
50	1	46	1	37	1	54	1	48	1
193	1	48	1	50	2	42	1	194	2
39	1	194	1	45	1	46	2	42	1
193	1	42	1	48	1	39	1	48	1
50	1	44	1	40	1	194	1	43	2
11	1	208	1	210	1	213	3	210	1
213	1	210	1	213	1	72	1	123	1
69	1	114	1	75	1	115	1	119	1
77	1	115	1	69	1	157	1	123	1
124	1	162	1	169	1	165	1	116	1
114	1	116	2	161	1	72	1	115	1
114	1	115	1	44	1	48	1	41	1
43	1	49	1	50	1	46	1	56	1
48	1	39	1	51	1	219	1	43	2
44	1	43	1	64	1	57	1	194	1
33	1	194	1	43	2	47	1	37	1
195	1	40	1	63	1	46	1	48	1
54	1	43	1	37	2	48	1	61	1
54	1	43	1	62	1	50	1	54	1
47	1	54	1	37	1	104	1	5	2
8	1	5	1	103	1	208	1	210	1
213	3	210	1	213	1	210	1	213	1
116	2	115	2	157	1	185	1	115	1
116	1	123	1	174	1	119	1	115	2
196	1	150	1	115	3	117	1	115	4
114	1	115	1	62	1	40	1	43	2
39	1	44	1	50	1	195	1	43	1
47	1	48	1	43	1	40	1	43	1
44	1	54	1	194	1	54	1	43	1
37	1	43	1	44	1	43	1	48	1
43	1	48	1	38	1	37	1	41	1
44	1	61	1	46	1	54	1	194	1
52	1	40	1	54	1	40	1	48	1
46	1	45	1	44	1	46	1	5	3
109	1	14	1	8	1	208	1	210	1
213	3	210	1	213	1	210	1	213	1
115	1	114	2	124	1	115	1	182	1
115	4	156	1	122	1	115	1	114	1
115	1	118	1	115	1	151	1	115	1
114	1	115	2	156	1	151	1	115	1
125	1	151	1	48	1	42	1	46	1
39	1	50	1	42	1	52	1	45	1
42	1	45	1	43	2	48	1	43	1
46	1	52	1	43	1	46	1	48	1
46	1	42	1	195	1	48	1	46	1
39	1	40	1	194	1	45	2	43	1
42	1	193	1	43	1	194	1	43	1
50	1	48	1	43	1	194	1	39	1
45	1	42	1	36	1	40	1	45	1
194	1	42	1	40	1	45	1	194	1
40	1	43	1	39	1	43	1	48	1
39	1	45	1	40	1	194	1	5	1
209	1	210	1	213	3	210	1	213	1
210	1	213	1	123	1	115	2	116	1

115	3	116	1	123	1	115	2	118	1
126	1	150	1	163	1	115	1	123	1
151	1	150	1	124	1	115	1	124	1
115	1	127	1	69	1	46	1	41	1
37	1	56	1	39	1	40	1	57	1
44	1	194	1	51	1	39	1	43	1
40	1	61	1	43	1	46	1	48	1
46	2	53	1	40	1	53	1	37	1
46	1	52	1	43	1	40	1	44	1
46	1	40	1	48	1	194	2	37	1
43	2	42	1	43	1	46	1	58	1
49	1	37	1	62	1	128	1	109	1
103	2	28	1	5	1	208	1	210	1
213	3	210	1	213	1	210	1	213	1
159	1	153	1	115	1	161	1	117	1
114	1	122	1	162	1	123	1	115	1
124	1	117	1	150	1	115	1	117	1
115	1	161	1	123	1	150	1	115	2
150	1	115	2	123	1	159	1	115	1
45	1	43	1	193	1	45	1	52	1
42	1	54	1	42	2	45	1	42	1
45	1	194	1	46	1	48	1	46	1
52	1	45	1	52	1	46	1	42	1
45	1	54	1	42	1	43	1	39	1
43	1	39	1	46	1	40	1	39	1
48	1	43	2	45	1	50	1	40	1
39	1	194	1	43	1	39	1	193	1
46	1	193	1	46	1	42	1	194	1
43	1	46	1	42	1	39	1	193	1
42	1	48	1	195	1	39	1	48	1
42	1	48	2	8	1	209	1	210	1
213	3	210	1	213	1	210	1	213	1
196	1	116	1	122	1	123	1	115	1
167	1	123	1	151	1	81	1	115	1
151	1	124	1	123	3	115	1	114	2
159	1	123	1	116	1	124	1	115	1
69	1	150	1	63	1	40	2	194	2
56	2	40	1	43	1	54	1	44	1
43	1	50	1	54	1	40	1	46	1
58	1	50	1	40	1	37	1	43	1
47	1	40	1	46	1	37	1	39	1
50	1	37	1	52	1	56	1	49	1
43	1	56	1	49	1	43	2	46	2
40	1	43	1	48	1	37	1	194	1
5	1	190	1	11	1	5	1	8	1
17	1	209	1	210	1	213	3	210	1
213	1	210	1	213	1	216	1	114	1
115	1	114	1	122	1	115	2	122	1
123	1	114	1	115	1	123	1	159	1
115	1	122	1	114	1	115	1	118	1
123	1	114	1	123	1	115	4	157	1
114	1	154	1	115	1	32	1	39	1
48	1	42	1	39	1	44	1	34	1
43	1	48	1	193	1	54	1	39	1
43	2	42	1	39	1	45	1	39	1

194	1	43	1	194	1	50	1	42	1
48	1	42	2	45	1	194	1	40	2
193	1	42	1	45	1	43	1	48	1
194	1	42	1	46	1	42	2	43	1
50	1	52	1	39	1	48	1	43	2
45	1	193	1	45	1	48	1	39	1
41	1	37	1	48	3	194	1	42	1
194	1	8	1	208	1	210	1	213	3
210	1	213	1	210	1	213	1	69	1
123	1	116	1	154	1	115	1	123	2
115	1	114	1	125	1	75	1	115	1
118	1	154	1	116	2	115	1	159	1
196	1	115	1	122	1	77	1	157	1
115	1	75	1	39	1	51	1	45	1
48	2	43	1	47	1	43	2	37	1
63	1	62	1	39	1	50	1	47	1
48	1	43	1	193	1	54	1	43	1
56	1	43	1	46	2	52	1	43	1
194	1	46	1	51	1	42	1	43	3
219	1	48	1	55	1	48	1	194	1
64	1	52	1	54	1	52	1	42	1
37	1	5	1	106	1	109	1	190	3
207	1	209	5	210	1	213	3	210	1
213	1	210	1	213	1	123	1	125	1
159	1	117	1	122	1	126	1	155	1
115	2	114	1	116	1	122	1	150	1
115	2	122	2	157	1	122	1	115	1
114	1	151	1	121	1	123	1	115	1
123	1	114	1	118	1	43	1	47	1
42	1	48	1	50	1	48	2	45	1
42	1	41	1	42	2	194	1	48	1
194	1	50	1	45	1	43	1	39	1
48	1	46	1	39	1	43	1	46	1
43	1	193	1	39	1	42	1	43	2
46	1	48	1	46	1	48	1	39	1
46	1	42	1	52	2	45	1	62	1
45	1	48	2	33	1	40	1	46	1
31	1	194	1	43	1	48	2	45	1
39	1	40	1	63	1	48	1	43	2
42	1	131	1	209	1	210	1	213	3
210	1	213	1	210	1	213	1	151	1
118	1	114	1	72	1	114	1	75	1
69	1	122	1	123	1	161	1	116	1
72	1	116	1	163	1	172	1	123	1
154	1	115	2	157	1	115	2	123	1
115	1	116	1	37	1	194	1	56	1
46	2	194	1	193	1	43	1	42	1
59	1	43	2	195	1	41	1	194	1
48	1	40	1	51	1	40	1	61	1
48	1	37	1	52	1	194	1	46	1
56	1	48	1	43	1	49	1	40	1
43	1	46	1	48	1	46	1	56	1
63	1	36	1	43	1	54	1	43	1
59	1	46	1	61	1	5	1	131	1
103	1	109	1	103	1	8	1	208	1

210	1	213	3	210	1	213	1	210	1
213	1	118	1	157	1	122	1	115	2
123	1	115	1	119	1	115	1	157	1
115	1	118	1	123	1	114	1	122	1
115	1	151	1	115	1	123	1	118	1
150	1	122	1	123	1	117	1	115	1
122	1	150	1	115	1	40	1	48	1
46	1	56	1	43	1	48	1	42	1
46	2	39	1	42	1	54	1	37	1
193	1	46	1	43	2	42	1	43	1
30	1	194	1	42	1	40	1	42	1
39	1	48	1	52	1	43	2	37	1
40	1	52	1	40	1	50	2	56	1
52	1	62	1	45	1	50	1	42	1
46	1	43	1	193	1	46	1	45	1
42	1	43	1	194	1	43	1	50	2
45	1	48	1	39	1	40	1	46	1
36	2	50	1	103	1	208	1	210	1
213	3	210	1	213	1	210	1	213	1
69	1	123	1	114	1	115	1	72	1
115	4	114	1	116	1	162	1	171	1
123	1	69	1	126	1	157	1	115	2
151	1	150	1	69	1	163	1	118	1
114	1	37	1	40	2	48	1	37	1
43	1	46	2	54	1	194	1	44	1
50	1	44	1	43	1	62	1	45	1
54	1	43	2	56	1	37	1	41	1
38	1	54	1	195	1	48	1	34	1
195	1	46	1	43	1	46	1	39	1
41	1	48	1	41	1	54	1	51	1
54	1	194	1	53	1	41	1	52	1
50	1	5	1	128	1	5	1	8	1
128	1	103	1	209	1	210	1	213	3
210	1	213	1	210	1	213	1	153	1
115	1	72	1	116	1	115	1	124	1
115	1	75	1	77	1	115	1	155	1
150	1	123	1	72	1	154	1	163	1
123	1	151	1	115	1	123	1	124	1
157	1	155	1	172	1	115	1	195	1
42	1	43	1	50	2	40	1	48	1
43	1	49	1	43	1	39	1	50	1
55	1	44	1	194	1	37	1	40	1
37	1	48	1	47	1	52	1	40	1
194	1	56	1	54	1	61	2	43	1
47	1	195	1	52	1	48	1	54	1
50	1	38	1	194	1	56	1	48	1
49	1	37	1	51	1	46	1	43	1
103	1	190	1	128	1	5	1	103	1
8	1	209	1	210	1	213	3	210	1
213	1	210	1	213	1	115	1	151	1
114	1	153	1	154	1	158	1	115	2
114	1	118	1	114	1	116	1	115	1
154	1	115	1	153	1	115	1	114	1
116	1	159	1	123	1	114	1	153	1
114	2	157	1	115	1	167	1	43	1

194	1	48	1	193	1	42	1	48	1
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51	1	36	1	46	1	40	1	195	1
46	1	43	1	38	1	48	1	40	1
48	1	50	1	53	1	194	1	48	1
40	1	44	1	111	1	5	1	7	1
11	1	2	1	9	1	135	1	6	1
4	1	191	1	14	1	104	1	9	1
19	1	6	1	192	1	14	1	12	1
9	1	12	1	19	1	9	1	11	1
103	2	130	1	5	1	208	1	210	1
213	3	210	1	213	1	116	1	115	1
155	1	159	1	72	1	115	1	124	1
154	1	122	1	157	1	87	1	116	1
123	2	154	1	152	1	163	1	151	1
69	1	123	1	125	1	115	2	157	1
150	1	115	1	51	1	48	2	46	1
48	1	49	1	48	1	41	1	46	1
194	1	51	1	45	1	42	1	54	1
52	1	194	1	47	1	37	1	43	1
38	1	54	1	47	1	43	2	47	1
52	1	35	1	59	1	43	1	46	1
56	1	52	1	48	1	44	1	194	1
41	1	193	1	52	1	48	1	40	1
47	1	43	1	40	1	54	1	8	1
5	1	8	1	103	1	5	1	103	1
209	1	210	1	213	3	210	1	213	1
159	1	118	1	115	2	122	1	157	1
117	1	159	1	153	1	114	3	115	1
152	1	159	1	115	2	161	1	118	1
123	1	115	2	116	1	123	1	115	1
123	1	124	1	115	1	50	1	39	1
43	1	50	1	39	2	45	1	48	1
49	1	37	1	45	2	44	1	52	1
39	1	43	1	45	1	48	1	51	1
40	1	42	1	39	1	40	1	52	1
50	1	37	1	40	1	47	1	46	1
52	1	43	1	45	1	39	1	195	1
39	1	46	1	43	1	40	1	42	1
36	1	45	1	46	1	43	1	52	1
43	1	48	1	193	2	39	1	42	1
48	1	193	1	43	2	42	1	47	1
56	1	193	1	195	1	194	1	209	1
210	1	213	3	210	1	213	1	69	1
114	1	156	1	69	1	161	1	114	1
124	1	117	1	123	1	115	2	124	1
115	3	151	1	215	1	150	1	69	1
115	1	151	1	116	1	124	1	115	1
127	1	151	1	194	1	43	1	46	1
48	1	43	1	37	1	43	1	37	1

46	2	43	1	37	1	50	1	40	1
44	1	46	1	194	1	40	1	43	1
195	1	43	1	219	1	37	1	54	1
50	1	42	1	53	1	194	1	52	1
64	1	46	1	195	1	48	1	41	1
43	1	48	2	40	1	39	1	194	1
44	1	43	1	205	-15	50	1	195	1
50	1	104	1	11	2	8	1	145	1
5	1	207	-3	209	1	210	1	213	3
210	1	213	1	208	1	210	1	213	3
210	1	213	1	216	1	90	1	97	1
99	1	90	1	91	1	200	1	91	1
124	1	67	1	166	1	78	1	114	1
115	2	159	1	78	1	115	1	82	1
114	1	79	1	119	1	115	1	116	1
115	1	118	1	114	1	118	1	115	1
73	1	158	1	116	1	83	1	154	1
197	1	115	1	75	1	124	1	157	1
115	1	151	1	123	1	86	1	71	1
77	1	73	1	197	1	162	1	77	1
165	1	127	1	118	1	194	1	40	1
47	1	49	1	37	1	48	1	195	1
46	1	50	1	46	1	38	1	43	2
39	1	53	1	40	1	195	1	194	1
5	1	132	1	9	1	109	1	15	1
192	1	109	1	2	1	104	1	5	1
104	1	6	1	8	1	110	1	12	1
6	1	9	1	2	1	104	1	13	1
9	1	16	1	9	1	104	1	15	1
111	1	8	1	209	1	210	1	213	3
210	1	213	1	218	1				

TABLE A-3. A-10A MARKER BAND CONDITIONS

5	75	69	415	11	34	72	353	14	13
45	243	140	7	159	175	161	69	142	37
161	69	163	17	144	45	165	11	27	2
57	34	86	7	59	22	87	7	61	16
88	4	28	11	29	1	63	8	64	2
5	75	69	415	11	34	72	353	14	13
45	243	140	7	159	175	161	69	142	37
161	69	163	17	144	45	165	11	27	2
57	34	86	7	59	22	87	7	61	16
88	4	28	11	29	1	63	8	64	2
5	75	69	415	11	34	72	353	14	13
45	243	140	7	159	175	161	69	142	37
161	69	163	17	144	45	165	11	27	2
57	34	86	7	59	22	87	7	61	16
88	4	28	11	29	1	63	8	64	2
5	75	69	415	11	34	72	353	14	13
45	243	140	7	159	175	161	69	142	37
161	69	163	17	144	45	165	11	27	2
57	34	86	7	59	22	87	7	61	16
88	4	28	11	29	1	63	8	64	2
218	1								

TABLE A-4. A-10A MARKER BAND CYCLES APPLICATION

PASS NUMBER	% OF LIFE ACCOMPLISHED	SEQUENCE TYPE	DEFINED ENDPOINTS
1	0 - 4%	Random	31404
2	4% - 8%	Random	31407
3	8% - 12%	Random	31413
4	12% - 16%	Random	31410
5	16% - 20%	Random	31404
6	20% - 24%	Random	31419
7	24% - 28%	Marker	20127
8	28% - 32%	Random	31416
9	32% - 36%	Random	31413
10	36% - 40%	Random	31407
11	40% - 44%	Random	31404
12	44% - 48%	Random	31422
13	48% - 52%	Marker	20127
14	52% - 56%	Random	31407
15	56% - 60%	Random	31416
16	60% - 64%	Random	31416
17	64% - 68%	Random	31407
18	68% - 72%	Random	31419
19	72% - 76%	Marker	20127
20	76% - 80%	Random	31410
21	80% - 84%	Random	31413
22	84% - 88%	Random	31407
23	88% - 92%	Random	31404
24	92% - 96%	Random	31428
25	96% - 100%	Marker	20127

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18.7	69.5	20.5	61.5	18.6	63.7	23.9	56.4	14.7	65.5
16.6	57.5	23.2	70.1	29.6	63.1	20.7	75.7	26.1	66.8
46.6	57.0	-6.0	1.7	-7.0	1.6	-11.0	66.8	24.1	61.5
26.1	66.8	-7.0	1.6	-11.0	5.2	-11.0	1.3	-7.0	1.6
-11.0	66.8	24.0	61.5	-11.0	5.2	-11.0	2.5	-17.0	8.1
-15.0	2.9	-22.0	76.7	30.3	69.4	51.2	61.6	36.4	51.2
36.2	64.4	41.2	59.4	29.2	74.5	50.3	64.4	34.9	50.3
6.6	40.2	23.6	31.8	9.6	28.4	5.5	39.1	23.0	52.0
28.2	69.4	52.0	63.9	35.1	52.0	31.8	79.4	52.6	68.3
38.7	52.6	30.3	69.4	51.2	61.6	5.8	22.5	15.0	33.3
29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	13.8	38.2	12.3	30.9
15.3	27.9	21.0	26.0	7.7	23.0	10.1	20.8	10.1	20.8
16.1	38.9	34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4
16.6	57.5	29.6	63.1	26.1	66.8	46.6	57.0	-7.0	1.6
-11.0	66.8	24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	46.0
24.0	66.8	-11.0	5.2	-11.0	2.5	-17.0	8.1	-15.0	2.9
-22.0	76.7	30.3	69.4	51.2	61.6	36.4	51.2	36.2	64.4
41.2	59.4	29.2	74.5	50.3	64.4	34.9	50.3	6.6	40.2
23.6	31.8	9.6	28.4	5.5	39.1	23.0	52.0	28.2	69.4
52.0	63.9	35.1	52.0	31.8	79.4	52.6	68.3	38.7	52.6
30.3	69.4	51.2	61.6	5.8	22.5	15.0	33.3	29.6	46.7
24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	13.8	38.2	12.3	30.9	15.3	27.9
21.0	26.0	7.7	23.0	10.1	20.8	10.1	20.8	16.1	38.9
34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4	16.6	57.5
29.6	63.1	26.1	66.8	46.6	57.0	-7.0	1.6	-11.0	66.8
24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	46.0	24.0	66.8
-11.0	5.2	-11.0	2.5	-17.0	8.1	-15.0	2.9	-22.0	76.7
30.3	69.4	51.2	61.6	36.4	51.2	36.2	64.4	41.2	59.4
29.2	74.5	50.3	64.4	34.9	50.3	6.6	40.2	23.6	31.8
9.6	28.4	5.5	39.1	23.0	52.0	28.2	69.4	52.0	63.9
35.1	52.0	31.8	79.4	52.6	68.3	38.7	52.6	30.3	69.4
51.2	61.6	5.8	22.5	15.0	33.3	29.6	46.7	24.2	54.2
11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8

12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	13.8	38.2	12.3	30.9	15.3	27.9	21.0	26.0
7.7	23.0	10.1	20.8	10.1	20.8	16.1	38.9	34.5	49.7
11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
27.0	44.0	20.5	61.5	23.9	56.4	16.6	57.5	29.6	63.1
26.1	66.8	46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5
26.1	66.8	-7.0	1.6	-11.0	46.0	24.0	66.8	-11.0	5.2
-11.0	2.5	-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4
51.2	61.6	36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5
50.3	64.4	34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4
5.5	39.1	23.0	52.0	28.2	69.4	52.0	63.9	35.1	52.0
31.8	79.4	52.6	68.3	38.7	52.6	30.3	69.4	51.2	61.6
5.8	22.5	15.0	33.3	29.6	46.7	24.2	54.2	11.1	47.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
13.8	38.2	12.3	30.9	15.3	27.9	21.0	26.0	7.7	23.0
10.1	20.8	10.1	20.8	16.1	38.9	34.5	49.7	11.6	50.9
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	27.0	44.0
20.5	61.5	23.9	56.4	16.6	57.5	29.6	63.1	26.1	66.8
46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5	26.1	66.8
-7.0	1.6	-11.0	46.0	24.0	66.8	-11.0	5.2	-11.0	2.5
-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4	51.2	61.6
36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5	50.3	64.4
34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4	5.5	39.1
23.0	52.0	28.2	69.4	52.0	63.9	35.1	52.0	31.8	79.4
52.6	68.3	38.7	52.6	30.3	69.4	51.2	61.6	5	

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12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	13.8	38.2	12.3	30.9	15.3	27.9	21.0	26.0
7.7	23.0	10.1	20.8	10.1	20.8	16.1	38.9	34.5	49.7
11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
27.0	44.0	20.5	61.5	23.9	56.4	16.6	57.5	29.6	63.1
26.1	66.8	46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5
26.1	66.8	-7.0	1.6	-11.0	46.0	24.0	66.8	-11.0	5.2
-11.0	2.5	-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4
51.2	61.6	36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5
50.3	64.4	34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4
5.5	39.1	23.0	52.0	28.2	69.4	52.0	63.9	35.1	52.0
31.8	79.4	52.6	68.3	38.7	52.6	30.3	69.4	51.2	61.6
5.8	22.5	15.0	33.3	29.6	46.7	24.2	54.2	11.1	47.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
13.8	38.2	12.3	30.9	15.3	27.9	21.0	26.0	7.7	23.0
10.1	20.8	10.1	20.8	16.1	38.9	34.5	49.7	11.6	50.9
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	27.0	44.0
20.5	61.5	23.9	56.4	16.6	57.5	29.6	63.1	26.1	66.8
46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5	26.1	66.8
-7.0	1.6	-11.0	46.0	24.0	66.8	23.4	66.8	-12.0	1.3
-11.0	5.2	-7.0	45.0	-10.0	2.7	-11.0	2.5	-17.0	8.1
-14.0	3.0	-15.0	2.9	-22.0	87.3	42.3	76.7	22.9	78.1
30.3	69.4	51.2	61.6	36.4	51.2	26.7	73.9	36.2	64.4
41.2	59.4	22.5	83.3	29.2	74.5	50.3	64.4	34.9	50.3
1.4	50.1	6.6	40.2	23.6	31.8	4.9	35.2	9.6	28.4
5.6	50.0	5.5	39.1	23.0	52.0	21.4	77.6	28.2	69.4
52.0	63.9	35.1	52.0	23.9	88.7	31.8	79.4	52.6	

10.1	20.8	10.1	20.8	13.2	42.0	16.1	38.9	31.8	52.4
34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	27.0	44.0	18.7	69.5	20.5	61.5	18.6	63.7
23.9	56.4	14.7	65.5	16.6	57.5	23.2	70.1	29.6	63.1
20.7	75.7	26.1	66.8	46.6	57.0	-6.0	1.7	-7.0	1.6
-11.0	66.8	24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	5.2
-11.0	1.3	-7.0	1.6	-11.0	66.8	24.0	61.5	-11.0	5.2
-11.0	2.5	-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4
51.2	61.6	36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5
50.3	64.4	34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4
5.5	39.1	23.0	52.0	28.2	69.4	52.0	63.9	35.1	52.0
31.8	79.4	52.6	68.3	38.7	52.6	30.3	69.4	51.2	61.6
5.8	22.5	15.0	33.3	29.6	46.7	24.2	54.2	11.1	47.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
13.8	38.2	12.3	30.9	15.3	27.9	21.0	26.0	7.7	23.0
10.1	20.8	10.1	20.8	16.1	38.9	34.5	49.7	11.6	50.9
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	27.0	44.0
20.5	61.5	23.9	56.4	16.6	57.5	29.6	63.1	26.1	66.8
46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5	26.1	66.8
-7.0	1.6	-11.0	46.0	24.0	66.8	-11.0	5.2	-11.0	2.5
-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4	51.2	61.6
36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5	50.3	64.4
34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4	5.5	39.1
23.0	52.0	28.2	69.4	52.0	63.9	35.1	52.0	31.8	79.4
52.6	68.3	38.7	52.6	30.3	69.4	51.2	61.6	5.8	22.5
15.0	33.3	29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	

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12.7	42.2	13.8	38.2	12.3	30.9	15.3	27.9	21.0	26.0
7.7	23.0	10.1	20.8	10.1	20.8	16.1	38.9	34.5	49.7
11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
27.0	44.0	20.5	61.5	23.9	56.4	16.6	57.5	29.6	63.1
26.1	66.8	46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5
26.1	66.8	-7.0	1.6	-11.0	46.0	24.0	66.8	-11.0	5.2
-11.0	2.5	-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4
51.2	61.6	36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5
50.3	64.4	34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4
5.5	39.1	23.0	52.0	28.2	69.4	52.0	63.9	35.1	52.0
31.8	79.4	52.6	68.3	38.7	52.6	30.3	69.4	51.2	61.6
5.8	22.5	15.0	33.3	29.6	46.7	24.2	54.2	11.1	47.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
13.8	38.2	12.3	30.9	15.3	27.9	21.0	26.0	7.7	23.0
10.1	20.8	10.1	20.8	16.1	38.9	34.5	49.7	11.6	50.9
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	27.0	44.0
20.5	61.5	23.9	56.4	16.6	57.5	29.6	63.1	26.1	66.8
46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5	26.1	66.8
-7.0	1.6	-11.0	46.0	24.0	66.8	-11.0	5.2	-11.0	2.5
-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4	51.2	61.6
36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5	50.3	64.4
34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4	5.5	39.1
23.0	52.0	28.2	69.4	52.0	63.9	35.1	52.0	31.8	79.4
52.6	68.3	38.7	52.6	30.3	69.4	51.2	61.6	5.8	22.5
15.0	33.3	29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12	

28.2	69.4	52.0	63.9	35.1	52.0	31.8	79.4	52.6	68.3
38.7	52.6	30.3	69.4	51.2	61.6	5.8	22.5	15.0	33.3
29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	13.8	38.2	12.3	30.9
15.3	27.9	21.0	26.0	7.7	23.0	10.1	20.8	10.1	20.8
16.1	38.9	34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4
16.6	57.5	29.6	63.1	26.1	66.8	46.6	57.0	-7.0	1.6
-11.0	66.8	24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	46.0
24.0	66.8	-11.0	5.2	-11.0	2.5	-17.0	8.1	-15.0	2.9
-22.0	76.7	30.3	69.4	51.2	61.6	36.4	51.2	36.2	64.4
41.2	59.4	29.2	74.5	50.3	64.4	34.9	50.3	6.6	40.2
23.6	31.8	9.6	28.4	5.5	39.1	23.0	52.0	28.2	69.4
52.0	63.9	35.1	52.0	31.8	79.4	52.6	68.3	38.7	52.6
30.3	69.4	51.2	61.6	5.8	22.5	15.0	33.3	29.6	46.7
24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	13.8	38.2	12.3	30.9	15.3	27.9
21.0	26.0	7.7	23.0	10.1	20.8	10.1	20.8	16.1	38.9
34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4	16.6	57.5
29.6	63.1	26.1	66.8	46.6	57.0	-7.0	1.6	-11.0	66.8
24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	46.0	24.0	66.8
23.4	66.8	-12.0	1.3	-11.0	5.2	-7.0	45.0	-10.0	2.7
-11.0	2.5	-17.0	8.1	-14.0	3.0	-15.0	2.9	-22.0	87.3
42.3	76.7	22.9	78.1	30.3	69.4	51.2	61.6	36.4	51.2
26.7	73.9	36.2	64.4	41.2	59.4	22.5	83.3	29.2	74.5
50.3	64.4	34.9	50.3	1.4	50.1	6.6	40.2	23.6	31.8
4.9	35.2	9.6	28.4	5.6	50.0	5.5	39.1	23.0	52.0
21.4	77.6	28.2	69.4	52.0	63.9	35.1	52.0	23.9	88.7
31.8	79.4	52.6	68.3	38.7	52.6	23.0	78.1	30.3	69.4
51.2	61.6	3.8	24.8	5.8	22.5	12.8	35.7	15.0	33.3
27.3	48.9	29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2

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12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	13.8	38.2	12.3	30.9
15.3	27.9	21.0	26.0	7.7	23.0	10.1	20.8	10.1	20.8
16.1	38.9	34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4
16.6	57.5	29.6	63.1	26.1	66.8	46.6	57.0	-7.0	1.6
-11.0	66.8	24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	46.0
-24.0	66.8	-11.0	5.2	-11.0	2.5	-17.0	8.1	-15.0	2.9
-22.0	76.7	30.3	69.4	51.2	61.6	36.4	51.2	36.2	64.4
41.2	59.4	29.2	74.5	50.3	64.4	34.9	50.3	6.6	40.2
23.6	31.8	9.6	28.4	5.5	39.1	23.0	52.0	28.2	69.4
52.0	63.9	35.1	52.0	31.8	79.4	52.6	68.3	38.7	52.6
30.3	69.4	51.2	61.6	5.8	22.5	15.0	33.3	29.6	46.7
24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	13.8	38.2	12.3	30.9	15.3	27.9
21.0	26.0	7.7	23.0	10.1	20.8	10.1	20.8	16.1	38.9
34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4	16.6	57.5
29.6	63.1	26.1	66.8	46.6	57.0	-7.0	1.6	-11.0	66.8
24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	46.0	24.0	66.8
-11.0	5.2	-11.0	2.5	-17.0	8.1	-15.0	2.9	-22.0	76.7
30.3	69.4	51.2	61.6	36.4	51.2	36.2	64.4	41.2	59.4
29.2	74.5	50.3	64.4	34.9	50.3	6.6	40.2	23.6	31.8
9.6	28.4	5.5	39.1	23.0	52.0	28.2	69.4	52.0	63.9
35.1	52.0	31.8	79.4	52.6	68.3	38.7	52.6	30.3	69.4
51.2	61.6	5.8	22.5	15.0	33.3	29.6	46.7	24.2	54.2
11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2	12	

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12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4
16.6	57.5	29.6	63.1	26.1	66.8	46.6	57.0	-7.0	1.6
-11.0	66.8	24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	46.0
24.0	66.8	-11.0	5.2	-11.0	2.5	-17.0	8.1	-15.0	2.9
-22.0	76.7	30.3	69.4	51.2	61.6	36.4	51.2	36.2	64.4
41.2	59.4	29.2	74.5	50.3	64.4	34.9	50.3	6.6	40.2
23.6	31.8	9.6	28.4	5.5	39.1	23.0	52.0	28.2	69.4
52.0	63.9	35.1	52.0	31.8	79.4	52.6	68.3	38.7	52.6
30.3	69.4	51.2	61.6	5.8	22.5	15.0	33.3	29.6	46.7
24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	13.8	38.2	12.3	30.9	15.3	27.9
21.0	26.0	7.7	23.0	10.1	20.8	10.1	20.8	16.1	38.9
34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4	16.6	57.5
29.6	63.1	26.1	66.8	46.6	57.0	-7.0	1.6	-11.0	66.8
24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	46.0	24.0	66.8
-11.0	5.2	-11.0	2.5	-17.0	8.1	-15.0	2.9	-22.0	76.7
30.3	69.4	51.2	61.6	36.4	51.2	36.2	64.4	41.2	59.4
29.2	74.5	50.3	64.4	34.9	50.3	6.6	40.2	23.6	31.8
9.6	28.4	5.5	39.1	23.0	52.0	28.2	69.4	52.0	63.9
35.1	52.0	31.8	79.4	52.6	68.3	38.7	52.6	30.3	69.4
51.2	61.6	5.8	22.5	15.0	33.3	29.6	46.7	24.2	54.2
11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	13.8	38.2	12.3	30.9	15.3	27.9	2	

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12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
13.8	38.2	12.3	30.9	15.3	27.9	21.0	26.0	7.7	23.0
10.1	20.8	10.1	20.8	16.1	38.9	34.5	49.7	11.6	50.9
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	27.0	44.0
20.5	61.5	23.9	55.4	16.6	57.5	29.6	63.1	26.1	66.8
46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5	26.1	66.8
-7.0	1.6	-11.0	46.0	24.0	66.8	-11.0	5.2	-11.0	2.5
-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4	51.2	61.6
36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5	50.3	64.4
34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4	5.5	39.1
23.0	52.0	28.2	69.4	52.0	63.9	35.1	52.0	31.8	79.4
52.6	68.3	38.7	52.6	30.3	69.4	51.2	61.6	5.8	22.5
15.0	33.3	29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	13.8	38.2
12.3	30.9	15.3	27.9	21.0	26.0	7.7	23.0	10.1	20.8
10.1	20.8	16.1	38.9	34.5	49.7	11.6	50.9	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	27.0	44.0	20.5	61.5
23.9	56.4	16.6	57.5	29.6	63.1	26.1	66.8	46.6	57.0
-7.0	1.6	-11.0	66.8	24.1	61.5	26.1	66.8	-7.0	1.6
-11.0	46.0	24.0	66.8	-11.0	5.2	-11.0	2.5	-17.0	8.1
-15.0	2.9	-22.0	76.7	30.3	69.4	51.2	61.6	36.4	51.2
36.2	64.4	41.2	59.4	29.2	74.5	50.3	64.4	34.9	50.3
6.6	40.2	23.6	31.8	9.6	28.4	5.5	39.1	23.0	52.0
28.2	69.4	52.0	63.9	35.1	52.0	31.8	79.4	52.6	68.3
38.7	52.6	30.3	69.4	51.2	61.6	5.8	22.5	15.0	33.3
29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12	

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-22.0	87.3	42.3	76.7	22.9	78.1	30.3	69.4	51.2	61.6
36.4	51.2	26.7	73.9	36.2	64.4	41.2	59.4	22.5	83.3
29.2	74.5	50.3	64.4	34.9	50.3	1.4	50.1	6.6	40.2
23.6	31.8	4.9	35.2	9.6	28.4	5.6	50.0	5.5	39.1
23.0	52.0	21.4	77.6	28.2	69.4	52.0	63.9	35.1	52.0
23.9	88.7	31.8	79.4	52.6	68.3	38.7	52.6	23.0	78.1
30.3	69.4	51.2	61.6	3.8	24.8	5.8	22.5	12.8	35.7
15.0	33.3	27.3	48.9	29.6	46.7	24.2	54.2	11.1	47.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
13.8	38.2	9.9	33.6	12.3	30.9	14.3	29.0	15.3	27.9
21.0	26.0	5.1	25.7	7.7	23.0	10.1	20.8	10.1	20.8
13.2	42.0	16.1	38.9	31.8	52.4	34.5	49.7	11.6	50.9
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	27.0	44.0
18.7	69.5	20.5	61.5	18.6	63.7	23.9	56.4	14.7	65.5
16.6	57.5	23.2	70.1	29.6	63.1	20.7	75.7	26.1	66.8
46.6	57.0	-6.0	1.7	-7.0	1.6	-11.0	66.8	24.1	61.5
26.1	66.8	-7.0	1.6	-11.0	5.2	-11.0	1.3	-7.0	1.6
-11.0	66.8	24.0	61.5	-11.0	5.2	-11.0	2.5	-17.0	8.1
-15.0	2.9	-22.0	76.7	30.3	69.4	51.2	61.6	36.4	51.2
36.2	64.4	41.2	59.4	29.2	74.5	50.3	64.4	34.9	50.3
6.6	40.2	23.6	31.8	9.6	28.4	5.5	39.1	23.0	52.0
28.2	69.4	52.0	63.9	35.1	52.0	31.8	79.4	52.6	68.3
38.7	52.6	30.3	69.4	51.2	61.6	5.8	22.5	15.0	33.3
29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	13.8	38.2	12.3	30.9
15.3	27.9	21.0	26.0	7.7	23.0	10.1	20.8	10.1	20.8
16.1	38.9	34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4
16.6	57.5	29.6	63.1	26.1	66.8	46.6	57.0	-7.0	1.6
-11.0	66.8	24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	46.0
24.0	66.8	-11.0	5.2	-11.0	2.5	-17.0	8.1	-15.0	2.9
-22.0	76.7	30.3	69.4	51.2	61.6	36.4	51.2	36.2	64.4
41.2	59.4	29.2	74.5	50.3	64.4	34.9	50.3	6.6	40.2
23.6	31.8	9.6	28.4	5.5	39.1	23.0	52.0	28.2	69.4
52.0	63.9	35.1	52.0	31.8	79.4	52.6	68.3	38.7	52.6
30.3	69.4	51.2	61.6	5.8	22.5	15.0	33.3	29.6	46.7
24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8

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20.5	61.5	23.9	56.4	16.6	57.5	29.6	63.1	26.1	66.8
46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5	26.1	66.8
-7.0	1.6	-11.0	46.0	24.0	66.8	23.4	66.8	-12.0	1.3
-11.0	5.2	-7.0	45.0	-10.0	2.7	-11.0	2.5	-17.0	8.1
-14.0	3.0	-15.0	2.9	-22.0	87.3	42.0	76.7	22.9	78.1
30.3	69.4	51.2	61.6	36.4	51.2	26.7	73.9	36.2	64.4
41.2	59.4	22.5	33.3	29.2	74.5	50.3	64.4	34.9	50.3
1.4	50.1	6.6	40.2	23.6	31.8	4.9	35.2	9.6	28.4
5.5	50.0	5.5	39.1	23.0	52.0	21.4	77.6	28.2	69.4
52.0	63.9	35.1	52.0	23.9	88.7	31.8	79.4	52.6	68.3
38.7	52.6	23.0	78.1	30.3	69.4	51.2	61.6	3.8	24.8
5.8	22.5	12.8	35.7	15.0	33.3	27.3	48.9	29.6	46.7
24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
14.3	29.0	15.3	27.9	21.0	26.0	5.1	25.7	7.7	23.0
10.1	20.8	10.1	20.8	13.2	42.0	16.1	38.9	31.8	52.4
34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	27.0	44.0	18.7	69.5	20.5	61.5	18.6	63.7
23.9	56.4	14.7	65.5	16.6	57.5	23.2	70.1	29.6	63.1
20.7	75.7	26.1	66.8	46.6	57.0	-6.0	1.7	-7.0	1.6
-11.0	66.8	24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	5.2
-11.0	1.3	-7.0	1.6	-11.0	66.8	24.0	61.5	-11.0	5.2
-11.0	2.5	-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4
51.2	61.6	36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5
50.3	64.4	34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4
5.5	39.1	23.0	52.0	28.2	69.4	52.0	63.9	30.1	52.0
31.8	79.4	52.6	68.3	38.7	52.6	30.3	69.4	51.2	61.6
5.8	22.5	15.0	33.3	29.6	46.7	24.2	54.2	11.1	47.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2

34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4	5.5	39.1
23.0	52.0	28.2	69.4	52.0	63.9	35.1	52.0	31.8	79.4
52.6	68.3	38.7	52.6	30.3	69.4	51.2	61.6	5.8	22.5
15.0	33.3	29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	13.8	38.2
12.3	30.9	15.3	27.9	21.0	26.0	7.7	23.0	10.1	20.8
10.1	20.8	16.1	38.9	34.5	49.7	11.6	50.9	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	27.0	44.0	20.5	61.5
23.9	56.4	16.6	57.5	29.6	63.1	26.1	66.8	46.6	57.0
-7.0	1.6	-11.0	66.8	24.1	61.5	26.1	66.8	-7.0	1.6
-11.0	46.0	24.0	66.8	-11.0	5.2	-11.0	2.5	-17.0	8.1
-15.0	2.9	-22.0	76.7	30.3	69.4	51.2	61.6	36.4	51.2
36.2	64.4	41.2	59.4	29.2	74.5	50.3	64.4	34.9	50.3
6.6	40.2	23.6	31.8	9.6	28.4	5.5	39.1	23.0	52.0
28.2	69.4	52.0	63.9	35.1	52.0	31.8	79.4	52.6	68.3
38.7	52.6	30.3	69.4	51.2	61.6	5.8	22.5	15.0	33.3
29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	13.8	38.2	12.3	30.9
15.3	27.9	21.0	26.0	7.7	23.0	10.1	20.8	10.1	20.8
16.1	38.9	34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4
16.6	57.5	29.6	63.1	26.1	66.8	46.6	57.0	-7.0	1.6
-11.0	66.8	24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	46.0
24.0	66.8	-11.0	5.2	-11.0	2.5	-17.0	8.1	-1	

21.0	26.0	7.7	23.0	10.1	20.8	10.1	20.8	16.1	38.9
34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4	16.6	57.5
29.6	63.1	26.1	66.8	46.6	57.0	-7.0	1.6	-11.0	66.8
24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	46.0	24.0	66.8
23.4	66.8	-12.0	1.3	-11.0	5.2	-7.0	45.0	-10.0	2.7
-11.0	2.5	-17.0	8.1	-14.0	3.0	-15.0	2.9	-22.0	87.3
42.3	76.7	22.9	78.1	30.3	69.4	51.2	61.6	36.4	51.2
26.7	73.9	36.2	64.4	41.2	59.4	22.5	83.3	29.2	74.5
50.3	64.4	34.9	50.3	1.4	50.1	6.6	40.2	23.6	31.8
4.9	35.2	9.6	28.4	5.6	50.0	5.5	39.1	23.0	52.0
21.4	77.6	28.2	69.4	52.0	63.9	35.1	52.0	23.9	88.7
31.8	79.4	52.6	68.3	38.7	52.6	23.0	78.1	30.3	69.4
51.2	61.6	3.8	24.8	5.8	22.5	12.8	35.7	15.0	33.3
27.3	48.9	29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	13.8	38.2
9.9	33.6	12.3	30.9	14.3	29.0	15.3	27.9	21.0	26.0
5.1	25.7	7.7	23.0	10.1	20.8	10.1	20.8	13.2	42.0
16.1	38.9	31.8	52.4	34.5	49.7	11.6	50.9	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	27.0	44.0	18.7	69.5
20.5	61.5	18.6	63.7	23.9	56.4	14.7	65.5	16.6	57.5
23.2	70.1	29.6	63.1	20.7	75.7	26.1	66.8	46.6	57.0
-6.0	1.7	-7.0	1.6	-11.0	66.8	24.1	61.5	26.1	66.8
-7.0	1.6	-11.0	5.2	-11.0	1.3	-7.0	1.6	-11.0	66.8
24.0	61.5	-11.0	5.2	-11.0	2.5	-17.0	8.1	-15.0	2.9
-22.0	76.7	30.3	69.4	51.2	61.6	36.4	51.2	36.2	64.4
41.2	59.4	29.2	74.5	50.3	64.4	34.9	50.3	6.6	40.2
23.6	31.8	9.6	28.4	5.5	39.1	23.0	52.0	28.2	69.4
52.0	63.9	35.1	52.0	31.8	79.4	52.6	68.3	38.7	52.6
30.3	69.4	51.2	61.6	5.8	22.5	15.0	33.3	29.6	46.7
24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	13.8	38.2	12.3	30.9	15.3	27.9
21.0	26.0	7.7	23.0	10.1	20.8	10.1	20.8	16.1	38.9
34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	27.0	44.0	20.5	61.5	23.9	56.4	16.6	57.5

12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	13.8	38.2
12.3	30.9	15.3	27.9	21.0	26.0	7.7	23.0	10.1	20.8
10.1	20.8	16.1	38.9	34.5	49.7	11.6	50.9	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	27.0	44.0	20.5	61.5
23.9	56.4	16.6	57.5	29.6	63.1	26.1	66.8	46.6	57.0
-7.0	1.6	-11.0	66.8	24.1	61.5	26.1	66.8	-7.0	1.6
-11.0	46.0	24.0	66.8	23.4	66.8	-12.0	1.3	-11.0	5.2
-7.0	45.0	-10.0	2.7	-11.0	2.5	-17.0	8.1	-14.0	3.0
-15.0	2.9	-22.0	87.3	42.3	76.7	22.9	78.1	30.3	69.4
51.2	61.6	36.4	51.2	26.7	73.9	36.2	64.4	41.2	59.4
22.5	83.3	29.2	74.5	50.3	64.4	34.9	50.3	1.4	50.1
6.6	40.2	23.6	31.8	4.9	35.2	9.6	28.4	5.6	50.0
5.5	39.1	23.0	52.0	21.4	77.6	28.2	69.4	52.0	63.9
35.1	52.0	23.9	88.7	31.8	79.4	52.6	68.3	38.7	52.6
23.0	78.1	30.3	69.4	51.2	61.6	3.8	24.8	5.8	22.5
12.8	35.7	15.0	33.3	27.3	48.9	29.6	46.7	24.2	54.2
11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	13.8	38.2	9.9	33.6	12.3	30.9	14.3	29.0
15.3	27.9	21.0	26.0	5.1	25.7	7.7	23.0	10.1	20.8
10.1	20.8	13.2	42.0	16.1	38.9	31.8	52.4	34.5	49.7
11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
27.0	44.0	18.7	69.5	20.5	61.5	18.6	63.7	23.9	56.4
14.7	65.5	16.6	57.5	23.2	70.1	29.6	63.1	20.7	75.7
26.1	66.8	46.6	57.0	-6.0	1.7	-7.0	1.6	-11.0	66.8
24.1	61.5	26.1	66.8	-7.0	1.6	-11.0	5.2	-11.0	1.3
-7.0	1.6	-11.0	66.8	24.0	61.5	-11.0	5.2	-11.0	2.5
-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4	51.2	61.6
36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5	50.3	64.4
34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4	5.5	39.1

51.2	61.6	5.8	22.5	15.0	33.3	29.6	46.7	24.2	54.2
11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	13.8	38.2	12.3	30.9	15.3	27.9	21.0	26.0
7.7	23.0	10.1	20.8	10.1	20.8	16.1	38.9	34.5	49.7
11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
27.0	44.0	20.5	61.5	23.9	56.4	16.6	57.5	29.6	63.1
25.1	66.8	46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5
26.1	66.8	-7.0	1.6	-11.0	46.0	24.0	66.8	-11.0	5.2
-11.0	2.5	-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4
51.2	61.6	36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5
50.3	64.4	34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4
5.5	39.1	23.0	52.0	28.2	69.4	52.0	63.9	35.1	52.0
31.8	79.4	52.6	68.3	38.7	52.6	30.3	69.4	51.2	61.6
5.8	22.5	15.0	33.3	29.6	46.7	24.2	54.2	11.1	47.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
13.8	38.2	12.3	30.9	15.3	27.9	21.0	26.0	7.7	23.0
10.1	20.8	10.1	20.8	16.1	38.9	34.5	49.7	11.6	50.9
12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	27.0	44.0
20.5	61.5	23.9	56.4	16.6	57.5	29.6	63.1	26.1	66.8
46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5	26.1	66.8
-7.0	1.6	-11.0	46.0	24.0	66.8	-11.0	5.2	-11.0	2.5
-17.0	8.1	-15.0	2.9	-22.0	76.7	30.3	69.4	51.2	61.6
36.4	51.2	36.2	64.4	41.2	59.4	29.2	74.5	50.3	64.4
34.9	50.3	6.6	40.2	23.6	31.8	9.6	28.4	5	

11.1	47.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	13.8	38.2	12.3	30.9	15.3	27.9	21.0	26.0
7.7	23.0	10.1	20.8	10.1	20.8	16.1	38.9	34.5	49.7
11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4
27.0	44.0	20.5	61.5	23.9	56.4	16.6	57.5	29.6	63.1
26.1	66.8	46.6	57.0	-7.0	1.6	-11.0	66.8	24.1	61.5
26.1	66.8	-7.0	1.6	-11.0	46.0	24.0	66.8	23.4	66.8
-12.0	1.3	-11.0	5.2	-7.0	45.0	-8.0	2.9	-10.0	2.7
-11.0	2.5	-17.0	8.1	-11.0	3.2	-14.0	3.0	-15.0	2.9
-22.0	100.0	33.3	87.3	42.3	76.7	12.6	88.1	22.9	78.1
30.3	69.4	51.2	61.6	36.4	51.2	15.1	85.5	26.7	73.9
36.2	64.4	41.2	59.4	15.1	92.1	22.5	83.3	29.2	74.5
50.3	64.4	34.9	50.3	12.1	61.6	1.4	50.1	6.6	40.2
23.6	31.8	1.1	42.3	4.9	35.2	9.6	28.4	15.8	61.4
5.6	50.0	5.5	39.1	23.0	52.0	13.2	83.1	21.4	77.6
28.2	69.4	52.0	63.9	35.1	52.0	14.7	98.9	23.9	88.7
31.8	79.4	52.6	68.3	38.7	52.6	12.6	88.1	23.0	78.1
30.3	69.4	51.2	61.6	1.1	27.6	3.8	24.8	5.8	22.5
9.7	38.8	12.8	35.7	15.0	33.3	24.7	51.6	27.3	48.9
29.6	46.7	24.2	54.2	11.1	47.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8
12.1	45.8	12.1	45.8	12.1	45.8	12.1	45.8	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2	12.7	42.2
12.7	42.2	12.7	42.2	12.7	42.2	13.8	38.2	7.3	36.6
9.9	33.6	12.3	30.9	13.4	29.6	14.3	29.0	15.3	27.9
21.0	26.0	2.5	2.6	5.1	25.7	7.7	23.0	10.1	33.8
10.1	20.8	13.2	42.0	16.1	38.9	28.7	55.5	31.8	52.4
34.5	49.7	11.6	50.9	12.8	47.8	12.8	47.8	12.8	47.8
12.8	47.8	12.8	47.8	12.8	47.8	15.4	42.4	15.4	42.4
15.4	42.4	15.4	42.4	15.4	42.4	15.4	42.4	15.4	